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The case study of physiotherapeutical treatment of a patient with distortion of knee joint.

Bachelor thesis

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Contents

Abstract

This is a case study after knee distortion. Thesis contains detailed documents from the examinations and therapeutic procedures that I have been followed during my practice at Centrum léčby pohybového aparátu.

The content of the first part analyzes the anatomy of knee and the surrounding muscles. Besides, I describe the injuries that can cause distortion of the knee, while analyzing multiple diagnosis and rehabilitation procedures according each case.

Second part contains the examination tests and rehabilitation plan for the current case that I have been working. After 10 sessions in the hospital I describe, specifically, the therapies and the final evaluation of my patient's state.

Key words: Knee, knee instability, distortion, physiotherapy, strengthening exercises, sensomotor function.

Declaration

This work is an evaluation in my research about distortion of knee joint. There is detailed description of all actions and methods that have been used to attain the optimal result of this Thesis. In addition, there is specific citation in the validity of the sources that have been written in the bibliography. Work has done under the guidance and supervision of Mgr. Zaher El Ali at the Centrum léčby pohybového aparátu.

Prague, 2011 Eleftherios N. Ioakeim

Dedication

This bachelor thesis is dedicated to my family for their support of these years and to my friends for all this time which we spent together with joys and sorrows. All these persons have a very special role in my life.

Also I would like to dedicate this bachelor thesis to my supervisor Mgr. Lenka Satrapová for her help to complete this work and my supervisor Mgr. Zaher El Ali for his help during my clinical practice in the hospital and for his general informations about physiotherapy.

Prague, 2011 Eleftherios N. Ioakeim

1. Knee anatomy

A thorough knowledge of the complex anatomy and biomechanical function of the structures of the knee is essential in order to make accurate clinical diagnoses and decisions regarding the treatment of the multiple-ligament-injured knee. The knee is a modified hinge joint that has a complex role. It must provide complete stability and control under a great range of loading conditions, yet allow flexion and rotation. The knee can be conceptualized as two joints—a tibiofemoral and a patellofemoral joint. The tibiofemoral joint allows transmission of body weight from the femur to the tibia while providing hinge-like, sagittal plane joint rotation along with a small degree of tibial axial rotation. Functionally, the quadriceps muscle group and patellofemoral articulation act to dissipate forward momentum as the body enters the stance phase of the gait cycle. The stability of the knee joint, along with static and dynamic restraints of the ligaments, capsule, and musculature crossing the joint is ensured by the bony architecture of the femur, tibia, and patella. The allowed motion of the joint is dictated by the architecture of the bones[5].

1.1 Osseous anatomy of the knee

Each compartment (*femorotibial joint and* patellofemoral joint) has its own structural identity. The osseous portions of the knee are the femur, tibia, patella, and fibula. The patella which is the largest sesamoid bone in the body is invested in the retinacular layer of the extensor mechanism receiving direct insertion of the deeper layer of the patellar tendon distally and the vastus intermedius proximally. Concave on its superficial surface, the articular surface of the patella contains a vertical central ridge that separates a broader lateral facet from a medial facet and a smaller, more medial odd facet. The patella articulates with the femoral sulcus or anterior articular surface of the distal femur,

Figure 1
Osseous anatomy of the knee
http://knol.google.com/k/knee-surgery#

which is a coalescence of the medial and lateral femoral condyles. Matching the patella, the lateral portion of the femoral sulcus is relatively broader and contains a higher lateral ridge than the medial portion[1]. The articular surface of the medial tibial plateau is concave, whereas the lateral plateau has an anteroposterior convexity. This topography accounts for the so-called screw-home mechanism, or internal rotation, of the femur on the fixed tibia as the knee approaches extension. Weight bearing occurs not only centrally on the medial and lateral tibial plateaus but also on the cephalad-sloping medial and lateral tibial eminences, much as a horseback rider bears weight in a saddle. The distal end of the femur has a medial and a lateral condyle, each of which has a distinct shape that corresponds to the shape of the tibial plateau. The shape of these condyles is important in the movement of the tibia on the femur. The proximal end of the tibia flares to create a plateau with medial and lateral sections divided by the tibial spine. The menisci deepen the contour of these plateaus to provide a good "seat" for the corresponding femoral condyles. This added depth is extremely important because the lateral femoral condyle and lateral tibial plateau are both somewhat convex[5].

1.2 Tibiofemoral Joint

The tibiofemoral joint is comprised of two condyloid articulations and it is the largest joint in the body. The medial and lateral femoral condyles articulate with the corresponding tibial plateaus. The enhancement of the conformity of the joint, as well as the assistance of the rotation of the knee[8] is served by the intervening medial and lateral menisci.

Simplistically, the femoral condyles are cam-shaped in lateral profile. The medial condyle has a larger radius of curvature than the lateral, and extends distal to the lateral on the anteroposterior (AP) projection. The lateral condyle extends anterior to the medial on the lateral projection, and can be identified by its terminal sulcus and groove for the popliteus insertion[14]. The proximal tibia is separated by the intercondylar eminence into an oval, concave medial plateau, and a circular, convex lateral plateau. The medial and lateral compartments are asymmetrical, particularly anteriorly. The lateral condyle of the femur is smaller than the medial, both in the AP and proximodistal directions. The rotation of the medial on the tibia through three axes, and the translation of the medial femur, to a limited extent, in the AP direction is allowed by the shapes of the condyles. The 3-degree lateral inclination of the tibial plateau in relation to the joint line, and 9° posterior slope, creates an overall valgus and posterior-inferior alignment of between 10° to 12° in most knees[1].

1.3 Patellofemoral Joint

The sellar joint between the patella and femoral trochlea is the patellofemoral articulation. This joint is of primary importance to knee stability mainly through its role in the extensor mechanism. The mechanical advantage of the extensor muscles is increased by the patella by transmitting the extensor force across the knee at a greater distance from the axis of rotation. As a result this increased moment arm reduces the quadriceps force required to extend the knee by 15% to 30%. The contribution of the patella to increasing the moment arm of the quadriceps varies over the range of motion. At full flexion, the lever arm of the quadriceps is increased approximately 10%, and this increases to 30% by 45° from full extension, and then once again decreases as the knee passes to terminal extension. The stability of the patella in the trochlear groove is a combination of bony, ligamentous, and muscular restrains. The patella responds to a set of three forces: the pull of the quadriceps, hamstrings, and a net compressive force on the patellofemoral surfaces. Additionally, the tracking of the patella within the trochlear groove is served by several soft tissue constraints. The constraints include the medial patellofemoral ligament, medial patellotibial ligament, medial retinaculum, medial patellomeniscal ligament, and lateral retinaculum. As it was stated before each compartment (*femorotibial joint and* patellofemoral joint) has its own structural identity.[1]

1.4 Extensor Mechanism

The extensor, or quadriceps femoris, mechanism consists in part of six muscles, one tendon, and the patellar ligament. The patella is a critical component of the extensor mechanism as its location allows greater mechanical advantage for the extension of the knee. The direction of pull exerted on the patella by the muscles provides for a great amount of dynamic stability of the patella.

Five areas consist the articulating surface of the patella. The extensor mechanism includes still other structures. The fat pad lies beneath the patellar tendon as it runs from the inferior patellar pole to the tibial tubercle. The patellofemoral and the patellotibial ligaments, thickenings in the extensor retinaculum that covers the anterior portion of the knee, stabilize the patella. The prepatellar bursa lies between the skin and the anterior surface of the patella. The infrapatellar bursa lies deep to the patellar tendon but in front of the infrapatellar fat pad. Trauma and by overuse can often cause inflammation in these two bursae. Other bursae are present about the anterior, medial, and lateral portions of the knee. The synovial membrane of the knee develops from three separate pouches. Seams from this fusion are present in the synovial membrane. These seams are termed plicae and are considered to be somewhat inconstant in nature. The plica usually courses medially beneath the extensor mechanism and runs distally along the medial patella border across the medial femoral condyle, finally attaching to the fat pad[8].

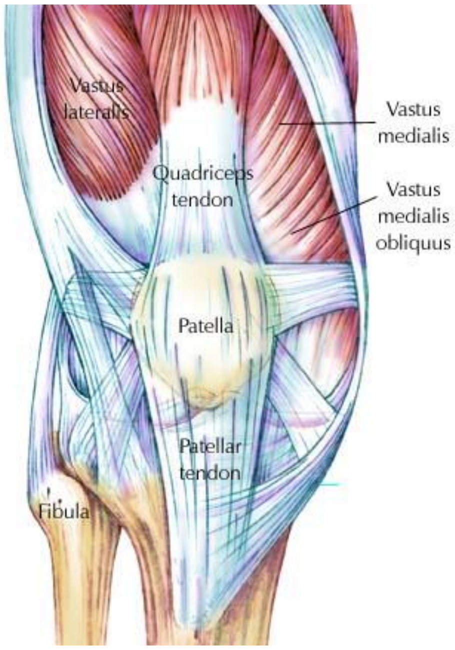

Figure 2
Muscles of the extensor mechanism
http://www.hughston.com/hha/a.extmech.htm

1.5 Medial compartment

A portion of the extensor retinaculum supports the medial compartment of the knee while other muscles of the thigh contribute in the dynamic stability of the knee. The ligamentous stability of the knee involves several planes of motion. When dealing with individuals who have knee instability dynamic stabilization is of the outmost importance. The adductor magnus muscle attaches to the femoral condyle at the adductor tubercle. The semimembranosus muscle with its five branches is an important medial stabilizer of the knee. Fibers from these branches support the posterior capsule and the posteromedial capsule and attach to the medial meniscus as well as to the tibia. The muscular attachment to the medial meniscus pulls the meniscus posteriorly from the joint as the knee flexes. The medial meniscus is intimately attached to the capsular ligaments at its periphery, thus these capsular ligaments are divided into the meniscofemoral and meniscotibial ligaments. These capsular ligaments lie deep to the tibial collateral ligament, which originates at the medial femoral epicondyle and courses distally and attaches beneath the pes anserinus group on the tibia. The medial capsular ligaments are longitudinally divided into three groups. The anterior third is seen anteromedially. The middle third provides stability through its thickened structures. The posterior third is often referred to as the posterior oblique ligament and is important in controlling anteromedial rotatory instability[1].

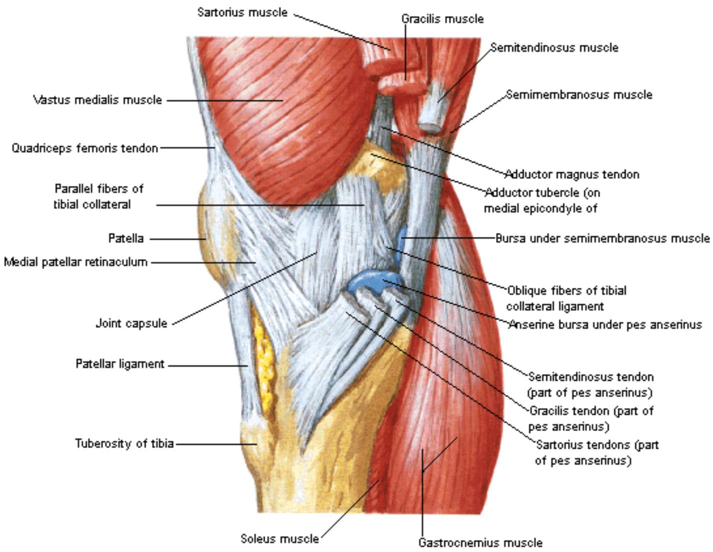

Figure 3
Medial view of the knee. The muscles of the medial compartment are indicated.
http://www.catsclem.nl/medisch/medknq.htm

The medial compartment also includes the posterior cruciate ligament. PCL is composed of posteromedial and anteromedial bundles and is often referred to as the "main stabilizer" of the knee. The tension within each bundle varies as the knee moves from flexion to extension. The posterior cruciate ligament tightens as the tibia internally rotates on the femur. Its origin is on the intercondylar surface of the medial femoral condyle and its insertion is on the fovea of the tibia[1].

1.6 Lateral compartment

The lateral compartment structures of the knee are somewhat analogous to the medial compartment structures. The iliotibial band and iliotibial tract are the main two components that provide the muscular support. The popliteus muscle originates on the lateral femoral condyle and inserts on the posterior. This insertion forms an important structure as the posterior third of the lateral capsular ligament is significantly reinforced[1].

The fibular collateral ligament overlies the lateral capsular ligaments. The lateral capsular ligaments are attached to the lateral meniscus in much the same way that ligaments attach to the medial meniscus. These lateral ligaments are divided into the meniscofemoral and meniscotibial sections of the lateral capsule. The anterior third of the lateral capsule provides little static support. The support against anterolateral rotatory instability is provided by the middle third of the lateral capsular ligaments. The posterior lateral third of the lateral compartment is supported by the arcuate complex. The complex is composed of the fibular collateral ligament, the popliteus tendon, the posterior third of the capsular ligament, and the arcuate ligament. The anterior cruciate ligament is also included in the lateral compartment. It consists of three bundles; the anteromedial bundle, the posterolateral bundle and the intermediate bundle which is between these two bundles. The tension on the bundles is altered as the knee moves from flexion to extension. It has become apparent that the lateral compartment is an important stabilizer of the knee. Its structure accounts for several different areas of stability and dilemma to repair it or not after injury remains unanswered[1].

Figure 4
The lateral knee compartment
http://aftabphysio.blogspot.com/2010/08/joints-of-lower-limb.html

2 Knee Joint Biomechanics and Kinematics

The goal of all joints is to allow motion of the bony segments surrounding the joint while withstanding the loads against gravity imposed by these movements. Biomechanics is defined as the science of the action of forces on the living body while kinematics definition is the study of body motion without regard for the cause of that motion. The ability of the knee joint to withstand tremendous forces during normal phases of ambulation is ought to the complex interaction of the femur, tibia, and the patella. Six planes of motion exist for the knee: anterior-posterior translation, medial-lateral translation, cephalad-caudad translation, flexion-extension rotation, internal-external rotation, and varus-valgus angulation[29]. A normal amount of motion without sacrificing stability during static activities such as standing to more dynamic functions such as walking, jogging, running, pivoting, and ascending or descending stairs must be provided by the knee joint. The interaction of the osseous anatomy, articular surface, ligaments, menisci, and surrounding musculature about the knee is the way of achieving these goals[6]. If any change in any of these components does occur it can alter the biomechanics of the knee joint by greatly increasing the loads and functional demands placed on the remaining structures. Before attempting any reconstructive procedures understanding the normal interactions of these structures is considered to be of vital importance[3].

2.1 Passive Motion of the Knee

The primary motion of the knee is flexion and extension. The knee joint averages 0° to 135° of flexion in the sagittal plane. The anatomy of the articular surfaces and the surrounding soft tissue capsule and ligaments dictates the passive motion of the knee joint[8]. Motion between full extension and 20° of flexion is accompanied by rolling of the lateral femoral condyle posteriorly more than the medial femoral condyle because of the distal asymmetry between the medial and lateral femoral condyles. This allows the femur and tibia to unlock from full extension and occurs without the assistance of any dynamic muscle involvement while it is also responsible for the coupled external rotation of the tibia which is commonly described as the “screw-home mechanism” of the knee and locks the knee into extension. The anterior cruciate ligament drives this screw home mechanism and absence of this control is the basis of the pivot shift test of an ACL deficient knee. After 20° of flexion, passive flexion of the knee joint occurs by a sliding motion, with relative tibial movement on the femur[11].

2.2 Anterior Cruciate Ligament (ACL)

Anterior Cruciate Ligament is the most important in providing passive restraint to anterior/posterior knee motion compared to the other knee ligaments. The biomechanics during ambulatory activities may be disrupted if one or both of the cruciates are disrupted. The primary function of the ACL is to prevent anterior translation of the tibia. In full extension, the ACL absorbs 75% of the anterior translation load, and 85% between 30° and 90° of flexion. In addition, other functions of the ACL include resisting internal rotation of the tibia and varus/valgus angulation of the tibia in the presence of collateral ligament injury.

Loss of the ACL leads to a decreased magnitude of this coupled rotation during flexion, and an unstable knee[3]. Its complex structure is considered to reflect its important contribution to knee-joint function. It has been proven to be a keystone to controlled, fluid, and stable flexion and rotation of the normal knee. While the ACL is a primary restraint to anterior translation of the tibia on the femur it is also a secondary restraint to internal rotation, varus, valgus, and hyperextension.[7,28,26] It should be noted that the ACL does not resist posterior drawer.

In order to elucidate the biomechanical properties of the ACL, many studies have been performed. The tensile strength of the ACL has been found to be around 2,200 N, but this is altered with age and repetitive loads. As the magnitude of the anterior drawer force increases, the in situ force of the ACL also increases. Sectioning the ACL produces a significant increase in anterior knee instability. The greatest amount of anterior translation after isolated ACL sectioning occurs between 15^0 and 45^0. The most effective position to conduct an anterior instability test during the clinical examination is at 30° of flexion. The ACL reaches ultimate stress at approximately 15% strain, and gross failure is expected to occur when strain exceeds 15% to 30% or displacement of about 1 cm. Levy subjected knees to a 100N anterior force and intact knees demonstrated, on average, 3.4 mm anterior translation at full extension, and maximum, 4.7 mm at 30° flexion. After isolated sectioning of the ACL, maximum anterior displacement at 30° was 18.1 mm[3].

It has been found that as the flexion angle increases, the displacement decreases. However, sectioning result in increased laxity at all angles. The translation in the anterior direction does not alter by later sectioning of the PCL. Takeda utilized a 5° of freedom kinematic linkage system, which allowed rotation, to investigate the contribution of the ACL to resistance against anterior drawer. The ACL restraint dropped to 74% to 83% of the total, indicating that constrained motion altered the normal function of the structures tested.[1,3]

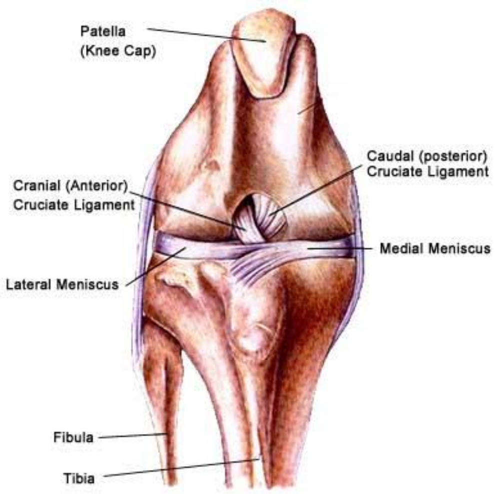

Figure 5
Knee representation. The anterior cruciate ligament and the posterior cruciate ligament are highlighted.
http://veterinaryreferralsurgery.com/article_crucate.php

2.3 Posterior Cruciate Ligament (PCL)

The average length of the PCL is 38 mm, and the average width is 13 mm. The ligament is enclosed within synovium and is, therefore, extra-articular in an anatomic sense. The overall position of the ligament in the joint is located near the longitudinal axis of rotation, just medial to the center of the knee. It is directed vertically in the frontal plane, and angles forward 30° to 56° in the sagittal plane, depending on the degree of knee flexion. A more vertical orientation in extension is assumed by the PCL, and a more horizontal position in flexion[12]. The femoral attachment of the PCL is located to the lateral surface of the medial condyle. The attachment is in the form of a segment of a circle, and horizontal in its general direction, with the knee extended[2].

The PCL is a primary restraint to posterior translation of the tibia on the femur at all positions of knee flexion, and a secondary restraint to varus-valgus and external rotation. The anterolateral band is tight in flexion and is most important in resisting posterior displacement of the tibia in 70° to 90° of flexion. The posteromedial portion resists posterior displacement of the tibia in this position as it is tight in extension. One technique that has recently gained popularity is the "double bundle" for PCL reconstruction, which attempts to restore both bands of the PCL.[1,3,8]

The PCL is the only isolated ligament that provides primary restraint to posterior translation at all angles of flexion. Isolated PCL ruptures may cause a mild increase in external rotation at 90° of knee flexion, but they do not greatly alter tibial rotation or varus/valgus angulation because of the intact extracapsular tissues and ligaments. The PCL does not resist anterior drawer. Butler ranked the ligamentous restraints to anterior-posterior motion in the human knee when displacement was fixed at 5 mm by utilizing the stiffness method. The PCL provided 90% to 95% of the total restraining force to posterior translation at 30° and 90° of knee flexion while no other structure was able to contribute more than 2% to the total restraint. Therefore, abnormal posterior tibial translation cannot occur without injury to the PCL. Isolated sectioning of the PCL resulted in an increase in posterior translation, and this increased as the knee was flexed, to a maximum at 90°. The increasing slackness in the remaining secondary restraints to posterior translation as the knee flexes is what these results mainly reflect[1].

The resulting secondary external rotation disappears right after sectioning the PCL. The vital role that this ligament plays in the natural rotation of the tibia during AP motion is therefore apparent. During posterior translation the PCL causes coupled external rotation. In other words, the PCL constitutes a primary mechanism for controlling and producing external rotation during the process of posterior translation. It is the center for rotational instability patterns of the knee due to its central location. Another function of the PCL is its influence on knee motion in the frontal plane, in addition to its known role in the sagittal plane. The popliteus muscle aids the PCL in resisting posterior tibial translation and enhancing stability. Harner et al. showed that the popliteus muscle reduced posterior translation of the tibia by 36% in a PCL-deficient knee.[1,3]

2.4 The menisci and meniscofemoral ligaments

Between the femur and tibia an intervening meniscus is located at the medial and lateral compartments of the knee. Grossly, the menisci are peripherally thick and convex, and centrally taper to a thin free margin. The meniscal surfaces conform to the femoral and tibial contours. The menisci are composed of collagen fibers that are arranged radially and longitudinally. The conformity to the femoral and tibial articular surfaces is provided by their wedge shape. The primary functions of the menisci are to distribute the load of the knee joint medially and laterally, to bear loads, and to absorb shock. The tensile stiffness and strength of the menisci are approximately ten times greater than those of articular cartilage. This allows the menisci to withstand the large hoop stresses generated by the knee joint. The deformation behavior of the meniscus is more dependent on the multidirectional arrangement of the collagen fibers rather than the type of collagen itself. Its viscoelastic properties are enhanced by its water content, aiding in its ability to distribute tensile and compressive loads and to withstand shear forces[8].

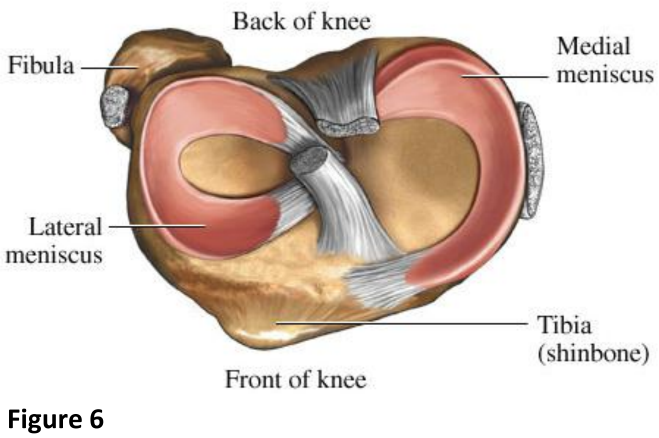

Figure 6
Superior view of the right knee. The meniscus is shown
http://deansomerset.com/2011/01/27/the-best-exercises-you-could-ever-do-quad-activation-progressions/

The medial meniscus is semicircular and approximately 3.5 cm in length. The posterior horn is wider than the anterior horn. The intermeniscal ligament serves as the primary attachment site for the anterior horn of the medial meniscus in approximately one quarter of cases[15]. Two meniscofemoral ligaments attach the lateral meniscus to the medial femoral condyle. The anterior meniscofemoral ligament is less than one third the diameter of the PCL, and arises from the posterior horn of the lateral meniscus. The posterior meniscofemoral ligament arises from the posterior horn of the lateral meniscus. It passes obliquely behind the PCL, and inserts on the medial femoral condyle, along with the posterior PCL fibers[8].

With knee flexion form 0° to 120°, the menisci move posteriorly. The meniscal motion is also affected by the rotation of the knee. The medial meniscus lacks the controlled mobility of the lateral meniscus. The medial meniscus is at increased risk of tear because the posterior oblique fibers of the deep MCL limit motion in rotation. The lateral meniscus is stabilized, and motion guided, by the popliteus tendon, popliteomeniscal ligaments, popliteofibular ligament, meniscofemoral ligaments, and lateral capsule. The medial meniscus provides greater restraint to anterior translation than does the lateral meniscus, by acting as a buttress. This fact can be demonstrated by evaluation of the meniscus-deficient knee. A biomechanical study by Levy of human cadaver knees compared intact knees to knees subjected to isolated medial meniscectomy, isolated ACL sectioning, or combined ACL sectioning and medial meniscectomy[1,8].

Isolated medial meniscectomy did not significantly alter anterior-posterior displacement, nor coupled internal rotation when compared with intact knees. Shoemaker evaluated the role of the meniscus in anterior-posterior stability under loaded conditions in the ACL-deficient knee. After ACL sectioning, the resistance provided by the menisci to an anteriorly directed force increased with increasing axial load (57% at 925N axial load). The higher the applied joint load, the greater the meniscal compression, and thus the greater the resistance to anterior force. The contribution from the lateral meniscus was minimal. Another function of the menisci is to serve as a secondary restraint to anterior translation in an ACL-deficient knee. The medial meniscus is more firmly fixed to the tibial plateau than the lateral meniscus, and it consequently has half the excursion of the lateral meniscus during knee flexion and rotation. This may account for the greater number of medial meniscal tears associated with ACL-deficient knees. The increased mobility of the lateral meniscus also aids the articular conformity in the “screw home” mechanism. Besider their role in joint stability, the menisci play also additional functional roles, such as load bearing and shock absorption[1,8].

2.5 Medial structures of the knee

The supporting structures of the medial side of the knee can be divided into three discrete layers. The most superficial layer, layer I, is the deep or crural fascia. This fascia is the first plane encountered deep to the subcutaneous tissue, and extends from the patella to the midline of the popliteal fossa. Layer II contains the superficial MCL, and is clearly defined by the parallel anterior fibers of this ligament. Layer III is the true joint capsule. The lines of attachment of the capsule follow the joint margins, except anteriorly, where it extends cephalad to form the suprapatellar pouch.[1,8]

2.5.1 Medial collateral ligament (MCL)

The MCL is composed of a superficial portion and a deep portion. The superficial MCL originates from the medial epicondyle, and runs downward as a broad triangular band approximately 11 cm to its tibial insertion, deep to the gracilis and semitendinosus tendons. The superficial MCL can be further subdivided into anterior and posterior portions. The anterior margin lies free except at its attachment sites to the tibia and femur, and is separated from the medial meniscus and deep capsular ligament by a bursa, where as the posterior margin passes obliquely backwards to an insertion in the medial meniscus[8].

The MCL is an important restraint to valgus rotation and a check against external rotation and straight medial and lateral translation of the tibia. Warren demonstrated that, regardless the order of ligament sectioning, the superficial portion of the MCL contributed greatest to stability. Sectioning the superficial portion of the ligament, while leaving the remainder intact, resulted in joint space opening under valgus load, over the entire range of motion while sectioning the deep ligament and posterior capsule produced almost no change in the behavior of the specimen under stress if the superficial fibers were intact[3].

2.5.2 Medial patellofemoral ligament

The medial patellofemoral ligament has been recently recognized as a major restraint to lateral displacement of the distal knee-extensor mechanism and for this reason, it deserves separate mention. The proximal fibers of the ligament proceed anteriorly toward the vastus medialis obliquus, fanning out proximally to insert on the undersurface of the vastus medialis obliquus and the aponeurotic fibers of the vastus intermedius. The distal fibers insert anteriorly on the superomedial patella, extending inferiorly from the medial process[3].

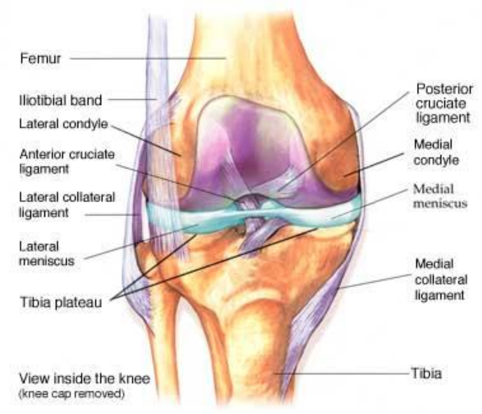

Figure 7
Simultaneous view of various medial and lateral structures of the knee. The medial collateral ligament, the iliotibial band and the lateral collateral ligament are noted among others.
http://www.aidmyknee.com/knee-injury.php

In order to evaluate the medial soft-tissue restraints of the extensor mechanism in 25 fresh-frozen knee specimens performed in extension conlan utilized the stiffness method. The major stabilizer preventing lateral displacement of the patella was the medial patellofemoral ligament, followed, in decreasing order, by the medial patellomeniscal ligament, the medial retinaculum, and the medial patellotibial ligament. The contribution to restraint from the medial patellofemoral ligament was 23% to 80%, with an average 53% of the total restraint[3].

2.6 Lateral structures of the knee

As it was discussed before the lateral compartment of the knee is divided into three sections. The anterior one third of the lateral compartment includes the capsular ligament, which extends posteriorly from the lateral border of the patella to the illotibial band. The middle one third is composed of the more superficial iliotibial (IT) band and a deeper capsular ligament. This section extends posteriorly to the lateral collateral ligament (LCL). The middle third capsular ligament attaches proximally to the lateral epicondyle of the femur, and distally to the tibial joint margin. The remaining posterior one third is termed as the posterolateral corner and its main contribution is to the stability of the lateral knee through the intricate arrangement of many structures. It is precisely this complexity that has resulted in so much study and controversy.[1,8]

2.6.1 Iliotibial band

The IT tract is an important stabilizer of the lateral compartment, and is instrumental in preventing varus opening of the knee. In full extension, the IT tract may act as an extensor as well as static stabilizer. As the knee flexes, the IT band tightens and moves posteriorly. The IT tract is tightest at 10° to 30° of flexion and, therefore, may be most vulnerable to injury at this position. Beyond 40°, the tract becomes a flexor of the knee. During extension, the IT tract moves anteriorly, and is thus spared in most cases of varus stress and posterolateral injury.

2.6.2 Lateral collateral ligament (LCL)

The LCL arises in a fan-like fashion in a fovea immediately posterior to the lateral epicondyle at an average 3.7 mm posterior to the apex of the epicondylar ridge. It is located between the superior fovea for the lateral gastrocnemius and the more distal popliteus. The LCL is superficial to the tendon of the popliteus. The average length of the ligament is reported from 59.2 to 71 mm[15] and has a minimum diameter at its midpoint, where it is elliptical in shape. The average AP diameter is 3.4 mm, and the average medial to lateral dimension is 2.3mm[1].

The LCL is tightest in extension and it progressively relaxes with flexion beyond 30^0 Because of its location posterior to the axis of flexion-extension rotation, and the decrease in the radius of curvature of the lateral condyle during flexion. The LCL is most important in resisting varus instability over this range as it appears to remain taut from 0° to 30°. Tensioning a graft in no more than 30° of flexion, close to neutral rotation, is recommended. The LCL is a primary restraint to varus at all positions of flexion and a secondary restraint to external rotation and posterior translation[1,25].

2.6.3 Posterolateral corner

The complexity of the posterolateral corner stems largely from the variable presence of many of the component structures. The dynamic and static stability of the knee is mainly provided by the structures in this region. The dynamic structures include the iliotibial band, the lateral head of the gastrocnemius, biceps femoris, and popliteus. While these components are invariably present the static structures are much more variable in presentation, and include the lateral collateral ligament, fabellofibular ligament, short lateral ligament, popliteofibular ligament, arcuate ligament, posterolateral capsule, posterior horn of the lateral meniscus, and lateral coronary ligament.[1,8]

The structures crossing the posterolateral corner of the knee provide resistance to tibial external rotation, varus rotation, and posterior tibial translation. Various sectioning studies have provided valuable insight into the interaction among the ligaments of this region. Combined sectioning of the posterolateral structures, with an intact PCL, result in maximum increased external rotation, varus rotation, and posterior translation at 30°. At low flexion angles, the bulk of the PCL is lax. When the PCL is sectioned along with these structures, posterior translation, varus, and external rotation further increase at all angles.[1,8]

2.6.4 Popliteus and popliteofibular ligament

The popliteus complex consists of both a dynamic component and a static component. The popliteus muscle originates from the posteromedial surface of the proximal 10 to 12 cm of the tibial metaphysic. The direct expansion of the semimembranosus blends into the popliteus muscle fascia. The medial part of the popliteus muscle inserts into the posterior horn of the lateral meniscus and capsule via the superior popliteomeniscal fascicle. The lateral part of the muscle joins the arcuate ligament superficially, as well as deep connecting fibers from the fibula, to form the musculotendinous junction[3].

The popliteus complex acts as a dynamic internal rotator of the tibia and as a static restraint to posterior tibial translation, varus rotation, and primary and combined external rotation of the tibia on the femur. The popliteus appears to function both statically and dynamically to prevent external rotation, rather than merely acting as an active internal rotator of the tibia. It is the only major structure positioned at an oblique angle in the posterolateral corner of the knee, and thus is well suited to prevent tibial external rotation during flexion from 20° to 130°, as well as varus from 0^0 to 90^0. When compared with other components of the deep-ligament complex, sectioning of the popliteus results in significant increases in external rotation at 90° of flexion.[2,15,25,27]

3 Knee Distortions

3.1 Knee Injuries

It has been demonstrated that the knee is an anatomically and biomechanically complex joint. The type and frequency of knee injuries has been reported by few published studies. It is known that sporting activities have become important components of modern life as most people have more leisure time. The increasing number of injuries is concomitant with the increasing popularity of sports as snowboarding, inline skating and mountain biking. It is usually the lower extremity that is involved, especially the knee. Majewski et al. analyzed the cases of 6434 patients that exhibited 19,530 injuries that were related to the knee joint. 68.1% of the patients were men, 31.6% were women and the remaining 0.3% was of ambiguous gender. Injury documentation included the patients' age, gender, sport, localization, and diagnosis. The precise documentation of the knee injury included lesions of the lateral collateral ligament (LCL), the medial collateral ligament (MCL), the anterior cruciate ligament (ACL), the posterior cruciate ligament (PCL), the lateral meniscus (LM), and the medial meniscus (MM)[12].

According to the study, minor knee distortions occurred without damage to any particular structure in 33.9% of the cases. Bone bruise can occur as an isolated finding usually after a direct hit but it is more often associated with other abnormalities such as ligamentous lesions, and frequently a typical pattern of bone bruise according to type of injury is seen[16]. Acute and chronic lesions of joint cartilage were seen in 10.6% of the patients. Contusions caused by a direct trauma were diagnosed in 5.5% of the cases. Dislocations, primarily of the patella, accounted for 3.3% of the injuries. Patellar dislocations are commonly associated with rupture of the medial patellar retinaculum and this may be well visualized on axial MRI sequences. Fractures of the three bones of the knee joint were seen only in 0.95% of the cases and knee dislocations were encountered rarely. Superficial skin wounds were seen in 0.66% of patients. Patella and quadriceps tendon injuries were observed in 0.19%. Chronic and degenerative alterations of the joint were diagnosed quite often. Traumatic ruptures, however, were rarely seen and finally a lesion of the popliteus muscle was observed in 0.08% of the cases[12].

Internal knee lesions accounted for 44.8% of the cases. Compared to all knee injuries, the incidence of internal knee injuries has been found as follows: ACL 20.3%, MM 10.8%, LM 3.7%, MCL 7.9%, LCL 1.1% and PCL 0.65%. Focusing on internal knee injuries, the anterior cruciate ligament (ACL) was damaged in 45.4% of the cases. Primary signs of a total ACL rupture are a complete disruption of the ACL fibers, abnormal signal intensity within the ligament and in the surrounding region, abnormal slope of the ACL, and nonvisualization of ACL fibers both in the sagittal and coronal planes. Hemorrhage and edema may appear as an amorphous mass producing mass effect. Medial meniscus lesion (MM) was the second most prevalent injury involving 24% of the internal injuries treated. The lateral meniscus (LM) was involved in only 8.2% of internal knee injuries. The ratio of lateral to medial meniscus injuries was 1:3. It has been described that the menisci are composed of fibrocartilage fibers. These are oriented mostly in a circumferential manner in the peripheral one third of the meniscus and both transverse and circumferential in the central two thirds of the meniscus. Because of this difference, the periphery of the meniscus is biomechanically more important than the inner part, and consequently a torn meniscus can still facilitate load transmission as long as the periphery remains intact. The periphery of the meniscus is vascularized and appears as the “red zone” on arthroscopy. Therefore, a tear that is confined to the periphery has greater healing potential than a tear that also involves the avascular central portion, also known as the “white zone” arthroscopically. The medial collateral ligament (MCL) was involved (17.6%) more often than the LCL (2.5%). A lesion of the posterior cruciate ligament (PCL), as expected, occurred in only 1.5% of the documented cases. This results in a ratio of 1:31 for posterior to anterior cruciate ligament lesions[12].

Aside from dislocations, fractures and skin wounds, 79.4% of the patients with internal knee trauma underwent surgery. However, 86.5% of all ACL tears diagnosed clinically had a diagnostic arthroscopy or a debridement with or without ligament repair. Only 48.9% of the patients with a LCL lesion had surgery. Half of those patients underwent surgery after multiple knee injuries. The ACL was injured in 49.5% of the cases where the internal knee injuries involved an operation. The incidence of internal knee injuries in all knees involving surgery were as follows: ACL 33.9%, MM 17.4%, cartilage lesions 9.3%, MCL 8.9%, LM 6%, patella dislocations 3%, fractures 1.3%, LCL 1%, PCL 1%, and tendon injuries 0.2%. During surgery 618 multiple knee injuries were seen. The ACL was involved in 40.5% of the cases (MM (23.4%), MCL (17.6%), LM (9.9%), LCL (1.8%), PCL (1.1%)). The ACL tear was mostly combined with MM (32.7%), MCL (24.6%), LM (15.1%), PCL (1.2%) and LCL (1.8%). Most knee injuries occurred while engaging in two popular European sports, soccer (35%) and skiing (26%). When comparing the knees of active members of various regional sports clubs, one sees that squash (2.39) and American football (1.46) have a higher risk of knee injuries than soccer (0.31) and skiing (1.08).

The analysis of the internal knee injuries revealed that soccer and skiing accidents are the main reason for lesions of all internal knee structures. When considering specific knee structures, the highest risk for lesions is seen during tennis and gymnastics for the LCL, during judo and skiing for the MCL, during handball and volleyball for the ACL, during handball for the PCL, during gymnastics and dancing for the LM, and during tennis and jogging for the MM[12].

3.2 Physical examination of the knee

The knee is particularly susceptible to traumatic injury because of its vulnerable location midway between the hip and the ankle, where it is exposed to the considerable forces transmitted through the distal extremity from the ground. A thorough examination of all knee structures should be a part of every knee evaluation. To ensure the most accurate diagnosis possible, it is crucial that testing maneuvers be performed correctly and that the examiner is aware of each maneuver's sensitivity, specificity, and limitations[13].

3.2.1 Anterior cruciate ligament tests

The anterior cruciate ligament (ACL) is among the main stabilizers of the knee, and injury to it often results in significant disability. Three of the most commonly applied tests to determine an ACL injury are the anterior drawer test, the Lachman test, and the pivot shift test[13].

Anterior drawer test.

When performing this test the subject is supine, the hip flexed to 45° and the knee flexed to 90°. The examiner sits on the subject's foot, with hands behind the proximal tibia and thumbs on the tibial plateau. Anterior force is applied to the proximal tibia while hamstring tendons are palpated with index fingers to ensure relaxation. Increased tibial displacement compared with the opposite side is indicative of an ACL tear[13].

Lachman test.

In this test the patient lies suspine while the knee is held between full extension and 15° of flexion. Femur is stabilized with one hand while firm pressure is applied to the posterior aspect of the proximal tibia in an attempt to translate it anteriorly. The test is positive, thus indicating ACL rupture, when there is anterior translation of the tibia with “soft” endpoint[13].

Pivot shift test.

The leg is picked up at the ankle with one of the examiner’s hands, and if the patient is holding the leg in extension, the knee is flexed by placing the heel of the other hand behind the fibula over the lateral head of the gastrocnemius. As the knee is extended, the tibia is supported on the lateral side with a slight valgus strain applied to it. In fact, this subluxation can be slightly increased by subtly internally rotating the tibia, with the hand that is cradling the foot and ankle. A strong valgus force is placed on the knee by the upper hand. This impinges the subluxed tibial plateau against the lateral femoral condyle, jamming the two joint surfaces together, preventing easy reduction as the tibia is flexed on the femur. At approximately 30 degrees of flexion, and occasionally more, the displaced tibial plateau will suddenly reduce in a dramatic fashion[13].

3.2.2 Posterior cruciate ligament tests

Three tests are commonly used to diagnose PCL injuries: the posterior sag sign, the posterior drawer test, and the quadriceps active test.

Posterior sag sign.

The patient lies supine with the hip flexed to 45° and the knee flexed to 90°. In this position, the tibia rocks back, or sags back, on the femur if the PCL is torn. Normally, the medial tibial plateau extends 1cm anteriorly beyond the femoral condyle when the knee is flexed 90°. If this step-off is lost, the step-off test is considered positive[13].

Posterior drawer test.

Subject is supine with the test hip flexed to 45°, knee flexed to 90°, and foot in a neutral position. The examiner is sitting on the subject’s foot with both hands behind the subject’s proximal tibia and thumbs on the tibial plateau. Apply a posterior force to the proximal tibia. Increased posterior tibial displacement as compared with the uninvolved side is indicative of a partial or complete tear of the PCL[13].

Quadriceps active test.

Subject is supine with knee flexed to 90° in the drawer-test position. The foot is stabilized by the examiner, and the subject is asked to slide the foot gently down the table. Contraction of the quadriceps muscle in the PCL-deficient knee results in an anterior shift of the tibia of _2mm. The test is qualitative[13].

3.2.3 Tests for the medial and lateral collateral ligaments

The MCL is among the most frequently injured ligaments in the knee. Valgus stress testing is the primary method used to diagnose MCL injury. Injuries of the lateral collateral ligament (LCL) are less common, and even fewer studies have evaluated the accuracy of the varus stress test in the diagnosis of this injury.

Valgus and varus stress tests.

The patient is supine on the examination table. Examiner should flex the knee to 30° over the side of the table, place 1 hand about the lateral aspect of the knee, and grasp the ankle with the other hand. At last he should apply abduction (valgus) stress to the knee. The test must also be performed in full extension[13].

3.2.4 Tests for patellofemoral disorders

Anterior knee pain is among the most common complaints that cause patients to consult a physician. Two of the most common tests used in the evaluation of patellofemoral disorders are the patellar compression, or grinding, test and the patella apprehension test.

Patellofemoral grinding test and patellofemoral compression test. The subject is lying supine with the knees extended. The examiner stands next to the involved side and places the web space of the thumb on the superior border of the patella. The subject is asked to contract the quadriceps muscle while the examiner applies downward and inferior pressure on the patella. Pain with movement of the patella or an inability to complete the test is indicative of patellofemoral dysfunction[13].

Apprehension test. The test is performed by pressing on the medial aspect of the patella with the knee flexed 30° with the quadriceps relaxed. It requires the thumbs of both hands pressing on the medial side of the patella to exert the laterally directed pressure. Often the finding is surprising to the patient, and he/she becomes uncomfortable and apprehensive as the patella reaches the point of maximum passive displacement, with the result that he/she begins to resist and attempts to straighten the knee, thus pulling the affected patella back into a relatively normal position[13].

3.2.5 Tests for meniscal injuries

Meniscal tears occur commonly; however, their clinical diagnosis is often difficult, even for an experienced clinician. Because the menisci are avascular and have no nerve supply on their inner two thirds, an injury to the meniscus can result in little or no pain or swelling, which makes accurate diagnosis even more challenging[13].

Joint line tenderness.

Joint line palpation is among the most basic maneuvers, yet it often provides more useful information than the provocative maneuvers designed to detect meniscal tears. Flexion of the knee enhances palpation of the anterior half of each meniscus. The medial edge of the medial meniscus becomes more prominent with internal rotation of the tibia, allowing for easier palpation. Alternatively, external rotation allows improved palpation of the lateral meniscus[13].

McMurray test.

With the patient lying flat, the knee is first fully flexed; the foot is held by grasping the heel. The leg is rotated on the thigh with the knee still in full flexion. By altering the position of flexion, the whole of the posterior segment of the cartilages can be examined from the middle to their posterior attachment. Bring the leg from its position of acute flexion to a right angle while the foot is retained first in full internal rotation and then in full external rotation[13].

Apley grind test.

The patient is prone. The examiner grasps one foot in each hand, externally rotates as far as possible and then flexes both knees together to their limit. The feet are rotated inward and the knees are extended. The therapist then applies his left knee to the back of the patient's thigh. The foot is grasped in both hands, the knee is bent to a right angle, and powerful external rotation is applied. Next, the patient's leg is strongly pulled up, with the femur being prevented from lifting off the couch. In this position of distraction, external rotation is repeated. The therapist leans over the patient and compresses the tibia downward. Again he rotates powerfully, and, if addition of compression produces an increase in pain, this grinding test is positive and meniscal damage is diagnosed[13].

Bounce home test.

The test is performed with the patient supine and the foot cupped in the examiner's hand. With the patient's knee completely flexed, the knee is passively allowed to extend. The knee should extend completely or bounce home into extension with a sharp endpoint. If extension is not complete or has a rubbery end feel, there is probably a torn meniscus or some other blockage[13].

3.3 Physical therapy for knee distortions

Knee injuries occasionally require physical therapy in order to heal properly and ensure an adequate range of motion in the joint. Although PT can last weeks or even months, and is often painful, it is a necessary component to proper healing and should not be overlooked. Sometimes the thought of physical therapy can be a daunting, but it will strengthen the knee, improving health and mobility. The primary goals of rehabilitation are to reduce pain, increase mobility, and to restore the function. A typical rehabilitation program is usually divided into 3 subsequent phases. In the initial phase (phase 1), the goal is to resolve knee impairments related to swelling and ROM deficits. As soon as knee joint effusion is eliminated and full ROM is restored, phase two is initiated[4].

The primary aim of phase two rehabilitation is to restore muscle strength and adequate neuromuscular responses. Consequently, this phase emphasizes intensive muscle strength training, plyometric exercises, and advanced neuromuscular exercises. The strength training can be performed as multiple sets of exercises for a minimum of 2 and a maximum of 4 sessions a week, with maximal effort for 3 or 4 sets of 6 to 8 repetitions. These guidelines are consistent with recent recommendations for training frequency, recovery, and exercise volume for recreational athletes at an intermediate level. Progression can be guided by a doseresponse theoretical framework, where the absolute load is increased from a targeted repetition number in each set. Both single- and multiple-joint exercises, open and closed kinetic chain exercises, as well as concentric, eccentric, and isometric strength exercises can be included[4].

Open kinetic chain exercises have been shown to be of considerable importance for quadriceps strength improvement, and threaten unwanted anterior translation of the tibia less than previously assumed. In addition to progressive strength training, plyometric exercises can be included in the program for enhancement of neuromuscular performance and strength development. Plyometric exercises are performed through variations of single-leg hops and drills focusing on maintaining the knee-over-toe position with soft landings to avoid landings with injurious dynamic loads. Furthermore, neuromuscular challenges are assured through balance and proprioception exercises such as single-legged squats on balance pads or the BOSU balance trainer[4].

As a specific neuromuscular enhancement, a sequence of various sessions with perturbation training should be included in the program. Perturbation training includes balance and stability exercises on custom-made roller board, rocker board, and platform, and involves perturbation of the support. Rehabilitation programs including perturbation training have been shown to enhance coordinated muscle activity and thus improve the dynamic stability of the knee early after injury. Each training session should not exceed 75 minutes, including a 10- to 15-minute warm-up on a stationary ergometer cycle, treadmill, or ellipse walker[4].

At this stage, there is no evidence to support the effectiveness of one specific form of exercise over another, although a combination of strengthening, aerobic and functional exercise is recommended. Exercise may also be delivered via individual treatments, supervised group classes or performed at home. Another consideration is the frequency and duration of an exercise program. Most exercise guidelines would suggest a physiological response can be attained with as few as 2–3 exercise sessions per week. However, the optimal exercise dosage is yet to be determined and should be individualized to each patient[4].

Adherence to exercise is often good in the first few months of commencing an exercise program but declines rapidly over time. Patient adherence is a key factor in determining improvements in outcome from exercise therapy in patients with knee distortions. Adherence is improved when patients receive attention from health professionals and believe in the effectiveness of the intervention. Self-efficacy, or one’s belief in their own ability to perform tasks, is also associated with greater adherence and better outcomes. Thus, strategies to maximize adherence to exercise should be incorporated, including educating patients about the disease and benefits of exercise, long-term monitoring review by a clinical exercise professional, regular follow-up or booster sessions, use of pedometers or a self-reported diary and support from family and friends. In overall extended outpatient therapy has been found to improve physical functioning, quality of life, and to reduce overall disability[4].

3.3.1 Manual methods

In these methods include some techniques which all of them are applied by therapist's hands. Therapist works with muscles and joints. During this therapy patient has to be cooperated with the therapist because sometimes patient's help is needed. The results of this type of therapy the most of time are visible and very easy observable. There are types of manual methods which characterized its technique.

Traction: Traction is a stretching force applied in a longitudinal direction of a segment (joint) or multisegment (spine). In segmental application it is very often used in techniques like joint play examination, mobilization, manipulation, P.N.F. and Bobbath. The effects of traction are relief from the pain and increasing the range of motion of a joint. The indications for this technique are tight soft tissues, nerve compression, and general stiffness. Contraindications for it, is an acute injury.

Mobilization: Is a technique which uses small rhythmic passive movements in a joint segment after reaching the end range.

Manipulation: Is a similar technique but in this technique used a quick thrust and not small rhythmic passive movements.

Soft tissue techniques: In this techniques include massage and manipulation of soft tissues like skin and fascia of a patient.[12,16]

3.3.2 Hydrotherapy

Hydrotherapy is a part of physiatry affecting the organism not only by the thermal energy but also by motion (hydromassage, bubble bath, Jacuzzi) or by specific chemical ingredients (minerals, carbon dioxide). There are a lot of types of hydrotherapy which are used and also they are popular. Some of them are baths with regulated temperature, sitting baths, Alternated baths, Sauna, Bath with ingredients (CO_2) and whirlpool baths.

Hydrotherapy is used for a diagnosis like distortion of knee joint. The main reason for it is, relaxing of the tensioned muscles, because after an injury like that is common some muscles to be tensioned. It is used for regeneration of the skin and soft tissues and for increasing the range of motion of the knee joint.[12,16]

3.3.3 Magnetotherapy

Magnetotherapy is a science studying the effects of magnetic fields on our health. Studies show that these fields can affect us positively and negatively. These magnetic fields are classified into constant and alternated. The effects of this therapy summarizing the data on physiological response to magnetic field exposures they find that these effects are not specific. Some of these effects are:

Vasodilation

Anti-inflammatory action

Spasmolytic activity

Healing acceleration

Increase ossification

Magnetotherapy will be helpful for a patient with distortion of knee joint if there is swelling and pain on this region. With the effects which are written it can be affected for the releasing of swelling. There is increasing of circulation and the metabolism of this area[4].

3.4 Knee Instability

Mainly knee instability comes after injury, acute or chronic of the anterior cruciate ligament, posterior cruciate ligament, medial collateral ligament or even injury of the posterolateral complex of the knee. In case of such an injury the knee joint has instability in specific movements, suddenly in these movements we observe small subluxing or a not physiologic opening of the joint

- Injury of Anterior Cruciate Ligament: problem of instability appears in movement of twisting, pivoting and turning.
- Injury of Posterior Cruciate Ligament: problem of instability appears during going down stairs or slopes.
- Injury of Posterolateral complex: problem of instability appears after turning or pivoting when the opening of the medial side of the joint is greater.

It is very common for patients to be confused when they have this feeling of the knee giving away that is most of the cases because of pattelofemoral dysfunction.

The treatment of knee instability depends on the type (chronic or acute), grade of the injury, and of course the patient's condition. Injury grades of 1 and 2 means an injury of non complete tear of the ligament and it does not need surgery. Higher grade of injury means that there is a complete tear of the ligament and needs a surgical treatment that includes ligament reconstruction in order to return the joint in normal stability in all the activites.[11]

3.5 Taping

The taping is elastic and it supports the infected muscles without any restriction in the movements. Also, it helps in faster healing. During the application of taping there is an elevation of the skin caused it will reduce the pressure on pain receptors around the area. Other benefits of taping are the supporting of the joints, correction of the direction for a movement and increase the stability of a joint. The tape when it is applied to athletes it can be for therapeutic reason or just for prevention before a match if there is any vulnerability.

With the application of taping a joint is more stable and there is decreasing of the possibilities for a unstable joint and a decreasing of risk of injuries. It is also affective for the gait of patient if, this joint is knee joint. The knee joint with the application of taping is stopped to be freely and the tapes are attached over the joint until below of it. It works similar with the ligaments of the knee joint.[11]

4 Sensorimotor system

Proprioception was first defined as a sense of position, posture, and movement by Dr. Charles Sherrington in the early 1900s. He noted that special receptors were present to transmit the afferent information into the central nervous system (CNS). During the 1960s, British physician Michael Freeman discovered the actual proprioceptive receptors in encapsulated nerve endings in the joints of cats. These results of Freeman and colleagues helped pioneer proprioceptive rehabilitation not only by identifying the importance of mechanoreceptors in joints, but also by noting the importance of the CNS in rehabilitation of peripheral joints. As a result the role of the CNS in chronic musculoskeletal dysfunction began to be investigated by various researchers and clinicians[17].

During the 1950s and 1960s, Dr. Vladimir Janda (1928–2002), a physiatrist and neurologist from the Czech Republic, noted that it was impossible to separate the sensory system and the motor system in the control of human movement and he used the term, ''sensorimotor system'' to describe it. Janda focused on providing input into the sensorimotor system ‘‘from the ground-up’’, noting the importance of foot proprioception, as he was influenced by the work of Freeman and colleagues. He emphasized the importance of optimal foot position and sensory stimulation to the sole of the foot to ensure maximal afferent information during stance. According to his theory the first postural key point is the foot. In order to ensure the maximum amount of appropriate afferent information entering the sensorimotor system, proprioceptive exercises are best performed without shoes (barefoot is best)[17].

Janda stated that performing exercises with a short foot is a prerequisite for the improvement of proprioception and postural stability. The training of the patient should begin in the short foot in sitting, using ‘‘passive modeling’’ or hand positioning to help facilitate the patient to perform an active short foot. For patients having difficulty maintaining a short foot, a strip of Thera-Band could sometimes be taped to the sole of the foot as an ‘‘active-assist’’ to help patients maintain the short foot position. The SI joint constitutes the next key point in postural stability. The lumbopelvic region must be maintained in a ‘‘neutral’’ position, neither too lordotic nor too kyphotic. Any dysfunction of the SI joint should be corrected prior to initiating SMT because of its role in proprioception. This helps to ensure proper length tension relationships of the joint mechanoreceptors sending information on posture to the CNS from the lumbopelvic region. In addition, facilitation of the transverse abdominus is cued by slightly drawing the umbilicus inward.

Finally, the cervical spine plays an important role in posture. These mechanoreceptors are important in maintaining equilibrium and postural reflexes from birth. Placing the cervical spine in a neutral position with the chin slightly tucked helps activate the deep neck flexors. SMT can begin only when the individual learns the proper positioning of these three proprioceptive points[17].

It has been made clear that the sensorimotor system, which is a subcomponent of the comprehensive motor control system of the body, is of extreme complexity. The term *sensorimotor system* was adopted by the participants of the 1997 Foundation of Sports Medicine Education and Research workshop to describe the sensory, motor, and central integration and processing components involved in maintaining joint homeostasis during bodily movements. The components that give rise to functional joint stability must be flexible and adaptable because the required levels vary among both persons and tasks. The process of maintaining functional joint stability is accomplished through a complementary relationship between static and dynamic components. Ligaments, joint capsule, cartilage, friction, and the bony geometry within the articulation comprise the static components. Dynamic contributions arise from feedforward and feedback neuromotor control over the skeletal muscles crossing the joint. Underlying the effectiveness of the dynamic restraints are the biomechanical and physical characteristics of the joint. These characteristics include range of motion and muscle strength and endurance[18].

4.1 Sensorimotor control of functional joint stability

Motor control for even simple tasks is a plastic process that undergoes constant review and modification based upon the integration and analysis of sensory input, efferent motor commands, and resultant movements. In this process the role of proprioceptive information stemming from joint and muscle receptors, as it was previously demonstrated, is of vital importance. Underlying the execution of all motor tasks are particular events, often very subtle, that are aimed at preparing, maintaining, and restoring stability of both the entire body (postural stability) and the segments (joint stability)[19].

Since the work of Palmer, one of the major tenets concerning the role of joint afferents in functional joint stability has been direct reflexive activation of alpha motor neurons (a MNs). This belief, however, is not uncontested and represents one of the biggest ongoing debates within the sensorimotor system[20]. Despite the controversial basic science and empirical support, in vivo human studies involving ankle and knee joint perturbations in conjunction with electromyography have been conducted and have produced varying results. Several factors must be considered with respect to the conclusions that can be drawn from this experimental model[10].

Joint afferents are more unanimously credited with eliciting similar effects on gamma motor neurons (γ-MNs) in contrast with the seemingly controversial activation of a-MNs. Interestingly, and in opposition to what many have claimed, Freeman and Wyke attributed increases in muscle activity in response to joint mechanoreceptor stimulation to activation of γ-MNs, not a-MNs. The ratio of change in force per change in length defines the term muscle stiffness. In contrast to muscle stiffness, which refers specifically to the stiffness properties exhibited by tenomuscular tissues, joint stiffness involves the contributions of all of the structures located within and over the joint. The extrinsic contribution of muscle stiffness arises from the increased reflexive neural activation of the muscle[10].

A beneficial characteristic for augmented functional joint stability is from a theoretic perspective, the increased muscle stiffness and, therefore, the enhanced joint stiffness. First, stiffer muscles should potentially resist sudden joint displacements more effectively. Although not all destabilizing forces may be entirely countered, many could potentially be lessened in magnitude, thereby reducing the incidence of joint subluxation and injury. This may be essential in maintaining functional stability when mechanical stability is deficient and may assist in explaining the moderate correlation between hamstring muscle stiffness and functional ability in anterior cruciate ligament (ACL)-deficient individuals found by McNair et al.

Second, intrinsically stiffer muscles enhance the potential capacities of the extrinsic component. Stiffer muscles as a result of increased activation are also believed to transmit loads to muscle spindles more readily, thereby reducing some of the lag time associated with initiation of reflexive activity. Higher motor control centers have been credited with compensating for static stabilizer deficiency losses through altered movement and muscle activation patterns. Similar to the spinal reflexes discussed, both direct and indirect evidence suggests that joint and ligmentous mechanoreceptors are important for supraspinal sensorimotor control over dynamic joint stability[21].

Direct evidence supporting the importance of articular receptors in sensorimotor control over joint stability by surgically resecting the posterior or medial articular nerves of cats were provider by Freeman and Wyke. Since both of these nerves convey afferent information predominantly from the knee joint, the surgical procedure caused the differentiation of the joint without disrupting mechanical stability. After the surgery, in addition to spinal-level motor alterations, the animals displayed changes in supraspinal motor programs controlling voluntary movements. Further, postural control adjustments that were initiated from visual and vestibular sources were also altered. Thus, it appears that proprioception is fundamental for sensorimotor control over joint stability, with articular receptors providing unique, subtle roles. Since γ-MN activation is largely influenced by peripheral afferent input, the adequacy and accuracy of the input become important considerations. Given the sensitivity of joint and ligament receptors through ranges of joint motion and their potent influences on γ-MN activity, it becomes quite likely that this indirect mechanism may outweigh the importance of the controversial direct a-MN reflexes. At higher motor levels, joint receptors may play essential roles in the development of motor program adaptations to compensate for losses in mechanical stability. To fully elucidate the precise mechanisms by which joint receptors contribute in all of these areas further research is needed[23].

4.2 Sensory receptors in the knee joint

The structures of the knee joint contain several types of sensory receptors, none of which, however, is unique or specific to the knee, but are found in most joints and muscles. They include the pacinian corpuscles, Golgi joint receptors, Golgi tendon receptors, Ruffini endings, muscles spindles, and bare nerve endings.

Bare nerve endings consist of the fine terminal nerve, 1–2 mm in diameter, lacking myelin sheathsand they are thoroughly distributed in the various tissues of the joint, including the articular surfaces and ligaments. These bare endings respond to deformation of the tissues in which they are embedded such as in bending, compression, and stretching. They are extremely sensitive to small changes in deformation of their capsule caused by mechanically applied pressure and initiate vigorous discharge of electrical potentials only during the application and removal of the stimulus, or during acceleration or deceleration of the moving joint. They are found in the joint capsule, cruciate ligament, and menisci, and may signal initiation and termination of joint motion, joint deformation, and so forth[21,23].

Ruffini endings consist of several endings emerging from a single myelinated axon. The Ruffini endings are slow-adapting, which implies that they may register changes in tissue stress and strain as well as continue to signal the new steady state for prolonged periods of time. This receptor, which registers both static and dynamic factors such as joint angle, velocity, intraarticular pressure, and strains, is found in the collateral and cruciate ligaments, capsule, and menisci[23].

Golgi receptors are thinly encapsulated, large corpuscles which are found in the muscle tendons, menisci, and collateral and cruciate ligaments. They are known to have a high threshold to mechanical deformation and may continue to signal mechanical changes for relatively prolonged periods before adapting to the new steady state of the tissue in which they reside. Even though Golgi receptors are different in their function they resemble one another at the different tissues. Golgi receptors embedded in the muscle's tendon are known to signal the force developed by the muscle, while Golgi receptors residing in the joint are known to signal the angle of the joint[23].

The muscle spindle consists of a short muscle fiber attached in series with a normal muscle fiber. The central part of the spindle contains spiral or bag-type receptors that initiate vigorous action potential trains in the afferent axon emerging from it and are highly sensitive to stretch[22].

4.3 Sensorimotor control of knee stability

It is now evident that the knee joint is endowed with extensive afferent innervations consisting of mechanoreceptors that are capable of recording its position, velocity and acceleration of motion, pressure, and pain associated with overload of the tissues. This afferent system subserves two roles: control of motion with a high degree of regulation against internal and external disturbances and maintenance of joint stability[9]. These two functions are accomplished by virtue of the spinal and cortical projection of the mechanoreceptors, which give rise to spinal reflexes as well as direct drive of the musculature crossing the knee. A direct reflex from the sensory nerves in the ACL to the muscles around the knee has been demonstrated in humans, but the role of this reflex in knee stability is poorly understood[24].

It is also clear that the musculature, in addition to control of motion, plays an important role in maintaining joint stability. The function of maintaining joint stability and protecting the tissues from damage is ongoing throughout all daily activities and is mostly subconscious, not requiring attention or training. It seems that high-performance athletes and other highly skilled persons demonstrate increases in joint efficiency, as evidenced by the decrease of antagonist muscle activity. Such skill acquisition, however, may reduce the ability of the antagonist musculature to protect the ligaments and place such skilled persons at high risk of ligamentous injury[9].

It was also shown that isolated quadriceps contraction may inflict undue strain on the ligaments and may by itself challenge joint stability. The excessive anterior displacement of the tibia associated with isolated quadriceps contraction explains why this muscle exhibits partial atrophy post ACL rupture, and indirectly confirms the role and importance of hamstring antagonist coactivation. The common prescription of quadriceps strength training post ACL injuries should therefore be altered to hamstring strength training as this muscle is capable of opposing the quadriceps effects and restoring stability to the joint. In general, well-balanced strengthening of the muscles crossing the knee is indicated for athletes and other active persons[22].

Although our knowledge of the biomechanics, neurophysiology, and anatomy of the knee as well as rehabilitation after cruciate ligament injury has grown, it is evident that there remains much to learn. This is the current research challenge.

5 Special Part

5.1 Methodology

Clinical work placement took place in the Centrum léčby pohybového aparátu Sokolovská 810/304, 190 00 Praha, Vysočany (v budově CLINICUM a.s.) from 06/06/2011 to 17/06/2011. During this period i have the chance to see my patient 8 times. After this time i visited hospital two more times to fulfill my therapy and to do the final kinesiologic examination. For the process of rehabilitation plan, there was usage of some tools: overball, spike ball and gymnastic ball, normal weights, posturomed and wobble-boards for stability exercise. Also, there was application of magnetic therapy, hydrotherapy and kinesio-tape.

The methods which I used during the sessions for the success of my therapy were:

-Proprioceptive Neuromuscular Facilitation (P.N.F.) according to Kabat.

-Post Isometric Relaxation (P.I.R.) according to Lewitt.

-Joint Play mobilization according to Lewitt.

-Strengthening exercises with the help of the tools.

-Soft tissue techniques.

-Sensomotor training.

I learnt all these methods, from this list, during my 3 years of study in Charles University Physical Education and Sport, Department of Physiotherapy.

There is a written informed consent signed from the patient, that I can use his study case for my bachelor thesis.

There is a written informed consent of the project of the thesis by the Ethics Committee of the faculty of Physical Education and Sport at Charles University with Approval Number: 0149/2011

Date: 15.08.2011

5.2 Anamnesis:

Name of the patient: S.M. Sex: Male

Date of Birth: 1983

Diagnosis: Distortion of the right knee joint.

5.2.1 Personal anamnesis:

Patient had an injury two months ago in a football game. During the game he had raff contact with an opponent. One month ago, patient felt pain because of a bad step during walking.

5.2.2 Childhood diseases:

Common childhood diseases.

5.2.3 Operations:

-1992 operation of hernia on both sides.

5.2.4 Abuses:

-Smoker, 20 cigarettes/ day

-Drinks alcohol socially.

5.2.5 Allergies:

-Cats

-Pollen

-Fruits

5.2.6 Pharmacological anamnesis:

-Ketonal for 1-2 weeks

-Midocalm for 1-2 weeks

5.2.7 Other diseases:

-Osteoporosis

5.2.8 Family anamnesis:

-Father: Chronic low back pain

-Mother: Osteoporosis

-Brother: Healthy

5.2.9 Social anamnesis:

-Not married and he lives alone.

-His flat is on the second floor and patient uses elevator for his transportation.

-He usually uses a bike for his transportation.

-His hobbies are football, floorball, running and cycling.

5.2.10 Occupational anamnesis:

Patient works in a company. He has an office job and he spends a lot of time in sitting position.

5.3 Initial Kinesiology Evaluation:

1st session (08.06.2011):

5.3.1 Present state:

Height: 170 cm Weight: 72 kg

BMI: 24.9 kg/m^2

He is not able to provide full extension and full flexion movements and he feels pain, from anterior and posterior side of the knee when he tries to do those movements.

The right knee joint is in semi-flexed position. There is also swelling on medial part and under patella of the knee joint and from back side is located exactly on popliteal fossa. His dominant side of the body is the left side, for both extremities upper and lower.

5.3.2 Postural examination (by Kendal):

<u>Posterior view</u>:

-Both lower extremities are in slight external rotation.

-Right knee joint is in semi-flexed position.

-Slight sinistro convex scoliosis on medial part of thoracic spine.

-Left scapula is slightly higher than the right scapula.

-Both upper extremities are in slightly internal rotation.

-Left shoulder joint is slight higher than the right shoulder joint.

<u>Lateral view:</u>

-More loading on heels.

-Right knee joint is in semi-flexed position.

-Slight physiological lordosis on lumbar spine.

-Trunk goes backward.

-Both upper extremities are in slight internal rotation.

<u>Anterior view:</u>

-Both lower extremities are in slight external rotation.

-Right knee joint is in semi-flexed position.

-Left m. pectoralis major have bigger tone than right pectoralis major muscle.

-Left shoulder joint is slightly higher than the right shoulder joint.

5.3.3 Pelvis examination (by Kendal):

-Physiological anterior tilt of the pelvis.

5.3.4 Trendelenburg Test (one leg standing):

(We ask the patient to stand up on both legs. We ask the patient to lift one leg and to stay in this position for a few seconds. We provided it on both legs).

Right leg: Patient provided it but he is feeling unstable his knee joint and tremor of the muscles, around knee joint, is present.
Left leg: Patient provides it also without any problem and he is standing normally.

With squat:
Right leg: Patient does it without any problem or tremor of his muscles.
Left leg: Patient provides it but he feels his knee unstable and it is painful.

5.3.5 Gait examination (by Kendal):

-There is not full extension of his right knee joint.
-Left upper extremity has bigger movement than the right upper extremity.
-His gait examination is symmetrical.

Modification of gait examination:
Walking on tip toes: Patient is able to provide but there is not full extension of his right knee joint.
Walking with squats: Patient is not able to provide it.

5.3.6 Scale examination:

Right scale: 35 kg
Left scale: 37 kg
The result shows us that patient has the same loading on both legs.

5.3.7 Anthropometry examination (by Kendal):

Measurement	**Right lower extremity**	**Left lower extremity**
Anatomical length	83 cm	83 cm
Functional length	88 cm	88cm
Length of the thigh	46 cm	46 cm
Length of the middle leg	37 cm	37 cm
Length of the foot	25 cm	25 cm
Circumference of thigh	Quadriceps: 43 cm Vastus Medialis: 39 cm	Quadriceps: 45 cm Vastus Medialis: 40 cm
Circumference of knee joint	37 cm	35 cm
Circumference of the calf	35 cm	35 cm
Circumference of ankle joint	25 cm	25 cm
Circumference of the foot	24 cm	24 cm

5.3.8 Palpation examination (by Kendal):

Muscles:

<u>Right lower extremity:</u>

- M. Quadriceps (m. rectus femoris): hypotonic, hypotrophy
- M. Tensor fasciae latae: hypertonic, normal trophy
- M. Adductors (m. adductor longus, magnus, brevis) : normal tonus, normal trophy
- M. Hamstrings: hypertonic, hypotrophy
- M. Iliopsoas: normal tonus, normal trophy
- M. Gastrocnemius: normal tonus, normal trophy
- M. Gluteus maximus: normal tonus, hypertrophy
- M. Piriformis: normal tonus, normal trophy

Left lower extremity:

- M. Quadriceps (m. rectus femoris): normal tonus, hypertrophy
- M. Tensor fasciae latae: hypertonic, normal trophy
- M. Adductors (m. adductor longus, magnus, brevis): normal tonus, normal trophy
- M. Hamstrings: normal tonus, hypotrophy
- M. Iliopsoas: normal tonus, normal trophy
- M. Gastrocnemius: normal tonus, normal trophy
- M. Gluteus maximus: normal tonus, hypertrophy
- M. Piriformis: normal tonus, normal trophy

Skin and fascias:

Right lower extremity:

- Restriction in mobility of the skin on medial part and under patella of the knee joint and from back side exactly on popliteal fossa, where the swelling is present.
- Small restriction in mobility of fascia is also present on the same region.

Left lower extremity:

- Physiological mobility of the skin around the knee joint.
- Physiological mobility of the fascia around the knee joint.

5.3.9 Range of motion examination (by Kendal):

Knee joint:

	Right side		Left side	
Motion	**Active movement (degrees)**	**Passive movement (degrees)**	**Active movement (degrees)**	**Passive movement (degrees)**
Extension	-15	-5	0	0
Flexion	120	130	140	160

Ankle joint:

	Right side		Left side	
Motion	**Active movement (degrees)**	**Passive movement (degrees)**	**Active movement (degrees)**	**Passive movement (degrees)**
Plantar Flexion	40	45	40	45
Dorsiflexion	20	20	15	20

Hip joint:

	Right side		Left side	
Motion	**Active movement (degrees)**	**Passive movement (degrees)**	**Active movement (degrees)**	**Passive movement (degrees)**
Extension	10	10	10	10
Flexion	90	110	110	125
Abduction	40	45	40	45
Adduction	10	10	10	10
External rotation	40	45	40	45
Internal rotation	35	45	40	45

5.3.10 Muscle strength examination (by Kendal):

Muscle	Right lower extremity	Left lower extremity
Quadriceps	3+	5
Hamstrings	4-	5
Adductors	5	5
Tensor fasciae latae	4	4
Gastrocnemius	5	5
Iliopsoas	5	5

Notice: The patient felt tension, during the examination of quadriceps muscles and hamstrings muscles.

5.3.11 Muscle length examination (by Kendal):

Muscle	Right lower extremity	Left lower extremity
Quadriceps	0	0
Hamstrings	2	1
Adductors	0	0
Tensor fasciae latae	0	0
Gastrocnemius	0	0
Iliopsoas	0	0

5.3.12 Joint play examination (by Lewitt):

The patient was examined for possible restrictions of knee joint, ankle joint, tarsal-metatarsal joints and metatarsal-phalangeal joints on both lower extremities. There was not any restriction on these joints in every direction. Also, examination was done on head of fibula, patella and talocrural joint, and there was not present any restriction on them.

5.3.13 Neurological examination (by Lewit):

- Deep sensation test: Negative
- Lasseque test: Negative
- Rhomberg test: Negative
- Superficial sensation test: Negative

Patient was examined for tendon reflexes according to Lewit:

- Patellar tendon: 2
- Achilles tendon: 2

Notice: The neurological examination and the examination of reflexes was done on both lower extremities.

5.3.14 Specific test for instability examination of knee joint:

- Anterior drawer test: Negative
- Lachman test: Negative
- Posterior drawer test: Negative
- Valgus and varus stress test: Negative

5.3.15 Examination for stability on posturomed:

Patient stands on posturomed in the beginning on both legs and then after our instructions, he tried to stand on one leg or to provide a step on it. After a while it starts to move with his weight. With the help of this instrument is visible to notice, if there is good stability or not on the knee and if the tremor of the muscles, which are around it, is taking place.
Patient is able to stand on both legs on it without any difficulty. When the patient took the instructions to stand by one leg on it and he tried it with his injured leg, he had tendency to

fall down. However, patient provided it with physiological level of stability when he did it with his healthy leg.
Same results we noticed when the patient tried to provide a step on it with his injured leg.
General patient showed us that was unable to provide these stability examinations with his injured leg because the results were the moving of the knee joint, tremor of the muscles around it, the tendency to fall down and the last sign was the feeling from the patient that his knee is not stable on it. The result of this examination was positive.

5.3.16 Examination conclusion:

The patient is on a general good condition. The main problems which are hindering him to return to the prime physical condition are the shortening of muscles, specific hamstrings muscles, the weakness of quadriceps muscle and the swelling around his right knee joint. Also, the limitation of the range of motion of knee joint is noticed. At the end, the examination for stability with posturomed was positive, it means that patient could not stand on it and he did not have good stability. After the neurological examination, nothing serious is noticed. Also, after the initial kinesiologic examination it is noticed that patient gave us a sign about small dysfunctions. These are, not full extension of his right knee joint in posture examination and gait examination, during the Trendelenburg test tremor was present on his right knee joint and it also was looking unstable and an apparent and observable limitation in range of motion of his right knee joint.

5.3.17 Short and Long rehabilitation plan:

Short rehabilitation plan:

-Releasing the swelling

-Improving the range of motion (ROM) of the knee joint

-Strengthening of the muscles which are weak as we mentioned, especially in this case, m. quadriceps (m. rectus femoris and m. vastus medialis)

-Stretching and relaxing of the shorten muscles, especially in this case, m. semimembranosus.

-Correction of gait

-Magnetotherapy to relsease the inflammatory effects, the pain and for improving of the metabolic process.

-Hydrotherapy, especially Aqua-massage, for relaxing of the tensioned muscles, for regeneration of the skin and soft tissues and for increasing the range of motion of the knee joint.

Long rehabilitation plan:

-Improving the power of the muscles.

-Improving the stability of his knee joint.

-Decreasing of the possibilities for a new trauma, with muscle strengthening techniques according to Kendal and improving the deep stabilization of the patient.

-Education of the patient is fundamental to improve posture and loading of his weight equally to his both lower extremities.

5.3.18 Instruments used in the Rehabilitation process:

For the process of rehabilitation we need the usage of

-Kinesio-tape for the releasing of swelling around the knee joint.

-Magnetic therapy: pulse current (pulse 10ms/pause 30ms), intensity 54mV, time 25 min.

-Hydrotherapy: Aqua-massage, temperature 32^{o}C, time 15 min.

-Also there was usage of some tools: overball, spike ball and gymnastic ball, normal weights and posturomed.

5.4 Visits / Sessions

5.4.1 Session 1 (06/06/2011)

Report: Patient has difficulty to provide full flexion and full extension of knee joint. In both directions the pain is present. He feels also his right knee joint unstable when he tries to put his whole weight on it and when he tries to climb stairs.

Assessment: Swelling is placed on the anterior and posterior of his right knee joint. There is tension and hypertonisity in m. semitendinosus, and there is restriction of the fascia at the same place. M. rectus femoris is weak and hypotonic and m. vastus medialis is weak and hypotonic

Goals of the therapy:
-Relief the pain from knee joint
-Release the swelling and the restriction of the fascia
-Relax the m. semitendinosus
-Strength the m. rectus femoris and m. vastus medialis
-Correction of gait

Therapy's procedure:
-Soft tissue techniques for the swelling and fascia
-Stretching exercises for the m. semitendinosus
-PIR technique for m. semitendinosus
-Strengthening exercises for m. rectus femoris according to Kendal
-PNF, 1st diagonal flexion pattern and 2nd diagonal extension pattern with knee extension for m.vastus medialis and 1st diagonal flexion pattern and 2nd diagonal flexion pattern with knee extension for m. rectus femoris, slow reversal hold technique for strengthening.

Therapy's result: Patient is able to collaborate. The restriction of the fascia is less but he needs a lot of work until he reaches the desired level of fitness. But it is matter of few sessions to follow until fascia and swelling are completely released. M. rectus femoris and m. vastus medialis did not give us any response in the first session. Also, m. semitendinosus are still in tension.

5.4.2 Session 2 (07/06/2011)

Report: Today patient feels slightly stable his right knee joint than the first session. The feeling of the pain is less but it is still present. Also he still has difficulty to provide flexion and extension of knee joint.

Assessment: The muscles' condition of the patient is the same, as the first session. Swelling is slightly smaller but fascia and skin are still restricted. Also, the tension in m. semitendinosus is less.

Goals of the therapy:

-Relief the pain from knee joint

-Release the swelling and the restriction of the fascia

-Relax the m. semitendinosus

-Strength the m. rectus femoris and m. vastus medialis

-Correction of gait

Therapy's procedure:

-Soft tissue techniques for the swelling and fascia

-Stretching exercises for the m. semitendinosus

-PIR technique for m. semitendinosus

-Strengthening exercises for m. rectus femoris with an overball under the knee joint and to give instructions to the patient to push it with his knee downwards. This exercise patient provides it with his leg in neutral position for m. rectus femoris and in internal rotation of the hip joint for m. vastus medialis.

-PNF, 1st diagonal flexion pattern and 2nd diagonal extension pattern with knee extension for m.vastus medialis and 1st diagonal flexion pattern and 2nd diagonal flexion pattern with knee extension for m. rectus femoris, slow reversal hold technique for strengthening.

Therapy's result: Patient has good feeling about the condition of his knee joint. It is noticed a small progress in addition to the first session but fascia is still restricted. M. rectus femoris and m. vastus medialis showed us a sign that there is possibility to be in better condition and the tension in m. semitendinosus is less.

5.4.3 Session 3 (08/06/2011)

Report: Patient has a decreased feeling of the pain in addition to the previous sessions. He can stand on his injured leg for few seconds (after a while pain is being bigger). The range of motion on knee joint is bigger 7 degrees, in extension and flexion, than the previous sessions. The joint's stability starts to be better.

Assessment: Skin and fascia are movable but they had a small restriction. Swelling is only on the anterior part of knee joint and it is slightly released. M. rectus femoris and m. vastus medialis give us a sign that they started to become powerful as on his left lower extremity. M. semitendinosus has decreased tension and decreased hypertonisity in addition to the previous sessions.

Goals of the therapy:

-Relief the pain from knee joint

-Release the swelling on the anterior side of the knee joint and the restriction of the fascia

-Increase the stability of the right knee joint so patient to be able to stand on his injured leg with his whole weight.

-Relax and release the hypertonisity of the m. semitendinosus

-Strength the m. rectus femoris and m. vastus medialis

-Correction of gait

Therapy's procedure:

-Soft tissue techniques for the swelling and fascia

-Stretching exercises for the m. semitendinosus

-Massage to release the tension of the m. semitendinosus

-PIR technique for m. semitendinosus

-PNF, 1st diagonal flexion pattern and 2nd diagonal extension pattern with knee extension for m.vastus medialis and 1st diagonal flexion pattern and 2nd diagonal flexion pattern with knee extension for m. rectus femoris, slow reversal hold technique for strengthening.

-Exercise the patient on posturomed with instructions to provide 2 sets of half step x 5 times on it and 2 sets of one step across it x 5 times with his injured knee joint.

-Exercises in the fitness room: Overball exercises, 2 sets of 15 times by holding and pressing it between his knees. Pressing the overball against bed (ball is placed under knee and afterwards under Achilles tendon). This exercise patient provides it with his leg in neutral position for m. rectus femoris and in internal rotation of the hip joint for m. vastus medialis. 6-7 parts of wobble-boards on the floor and the patient from floor started to walk on this wobble boards for stability exercise.

Therapy's result: Fascia and skin have a small restriction in mobility and the swelling is almost released. Patient feels almost stable his knee joint, m. rectus femoris and m. vastus medialis are strengthen compared their previous condition. Also, m. semitendinosus has decreased tension and decreased hypertonisity.

5.4.4 Session 4 (10/06/2011)

Report: Patient hasn't felt any pain in his knee and he is happy because he is sure that he can control his body during different activities with less effort. When he tried to provide extension and flexion of his knee joint it is noticed that the movement is slightly bigger 4 degrees than the last session.

Assessment: There is smaller restriction than the last session and with the help of the soft tissue techniques they will be movable normally like before his injury. Swelling is same like last session. M. rectus femoris and m. vastus medialis are slightly powerful and it is noticed that they will be in a very good level after the end of our sessions. In the same condition is m. semitendinosus, although tension is decreased.

Goals of the therapy:

-Release the swelling on the anterior side of the knee joint and the restriction of the fascia

-Increase the stability of the right knee joint so patient to be able to stand on his injured leg with his whole weight.

-Relax and release the hypertonisity of the m. semitendinosus

-Strength the m. rectus femoris and m. vastus medialis

-Correction of gait

Therapy's procedure:

-Soft tissue techniques for the swelling and fascia

-Stretching exercises for the m. semitendinosus

-Massage to release the tension of the m. semitendinosus

-PIR technique for m. semitendinosus

-PNF, 1st diagonal flexion pattern and 2nd diagonal extension pattern with knee extension for m.vastus medialis and 1st diagonal flexion pattern and 2nd diagonal flexion pattern with knee extension for m. rectus femoris, slow reversal hold technique for strengthening.

-Exercise the patient on posturomed with instructions to provide 2 sets of half step x 5 times on it and 2 sets of one step across it x 5 times with his injured knee joint.

-Exercises in the fitness room:. Overball exercises, 2 sets of 15 times by holding and pressing overball between his knees. Pressing the overball against bed (ball is placed under knee and afterwards under Achilles tendon). This exercise patient provides it with his leg in neutral position for m. rectus femoris and in internal rotation of the hip joint for m. vastus medialis. 6-7 parts of wobble-boards on the floor and the patient from floor started to walk on this wobble boards for stability exercise. Against the wall 2 sets of squats x 5 times with knees in valgus position.

Therapy's result: There is no restriction in mobility of the skin and fascia around the knee joint and the swelling is almost released. M. rectus femoris and m. vastus medialis showed us that they have power but they need work to return in their condition level as they were before the injury and m. semitendinosus has decreased tension and decreased hypertonisity. The stability of the joint showed us that it can be better in session to session.

5.4.5 Session 5 (13/06/2011)

Report: Patient noticed a significant improvement about his condition because pain weakness is not present. Range of motion is in same level as last session.

Assessment: M. semitendinosus is slightly hypertonus and painless. M. rectus femoris and m. vastus medialis are showing us that have power but after the everyday sessions look tired. Swelling and restriction of the fascia are limited.

Goals of the therapy:

-Release exactly the swelling the restriction of the fascia

-Increase the stability of the right knee joint so patient to be able to stand on his injured leg with his whole weight.

-Relax and release the hypertonisity of the m. semitendinosus

-Strength carefully the m. rectus femoris and m. vastus medialis because they look tired

-Correction of gait

Therapy's procedure:

-Soft tissue techniques for the swelling and fascia

-Stretching exercises for the m. semitendinosus

-Massage to release the tension of the m. semitendinosus

-PIR technique for m. semitendinosus

-PNF, 1st diagonal flexion pattern and 2nd diagonal extension pattern with knee extension for m.vastus medialis and 1st diagonal flexion pattern and 2nd diagonal flexion pattern with knee extension for m. rectus femoris, slow reversal hold technique for strengthening.

-Exercise the patient on posturomed with instructions to provide 2 sets of half step x 5 times on it and 2 sets of half step x 5 times with holding a ball. 2 sets of one step across it x 5 times with his injured knee joint.

-Exercises in the fitness room: Exercises with the overball, 2 sets of 15 times by holding and pressing overball between his knees. Pressing the overball against bed (ball is placed under knee and afterwards under Achilles tendon). This exercise patient provides it with his leg in neutral position for m. rectus femoris and in internal rotation of the hip joint for m. vastus medialis. 6-7 parts of wobble-boards on the floor and the patient from floor started to walk on this wobble boards for stability exercise. Against the wall 2 sets of squats x 5 times with knees in valgus position. Exercise with 2 sets of 10 times each leg, step forward in squat. Exercise with 2 sets of 10 times with 5 kg to strength the quadriceps muscle group in right lower extremity.

Therapy's result: The restriction in mobility of the skin and fascia is close to normal and swelling also is close to normal level. In every session m. rectus femoris and m. vastus medialis were present with more power. M. semitendinosus has decreased tension and hypertonisity in session to session.

5.4.6 Session 6 (14/06/2011)

Report: The extension and the flexion of knee joint have bigger 5 degrees range of motion than the previous session. Patient feels his knee joint in better state than the previous session.

Assessment: M. semitendinosus is slightly hypertonus but not painless. Swelling and the restriction of the fascia are close to normal level. M. rectus femoris and m. vastus medialis are slightly tired but powerful.

Goals of the therapy:

-Release exactly the swelling the restriction of the fascia

-Increase the stability of the right knee joint so patient to be able to stand on his injured leg with his whole weight.

-Relax and release the hypertonisity of the m. semitendinosus

-Strength carefully the m. rectus femoris and m. vastus medialis because they look tired

-Correction of patient's gait.

Therapy's procedure:

-Soft tissue techniques for the swelling and fascia

-Stretching exercises for the m. semitendinosus

-Massage to release the tension of the m. semitendinosus

-PIR technique for m. semitendinosus

-PNF, 1^{st} diagonal flexion pattern and 2^{nd} diagonal extension pattern with knee extension for m.vastus medialis and 1^{st} diagonal flexion pattern and 2^{nd} diagonal flexion pattern with knee extension for m. rectus femoris, slow reversal hold technique for strengthening.

-Exercise the patient on posturomed with instructions to provide 2 sets of half step x 5 times on it and 2 sets of one step across it x 5 times with his injured knee joint.

-Exercises in the fitness room: Exercises with the overball, 2 sets of 15 times by holding and pressing overball between his knees. Pressing the overball against bed (ball is placed under knee and afterwards under Achilles tendon). This exercise patient provides it with his leg in neutral position for m. rectus femoris and in internal rotation of the hip joint for m. vastus medialis. 6-7 parts of wobble-boards on the floor and the patient from floor started to walk on this wobble boards for stability exercise. Against the wall 2 sets of squats x 5 times with knees in valgus position. Exercise with 2 sets of 10 times each leg, step forward in squat. Exercise with 2 sets of 10 times with 5 kg to strength the quadriceps muscle group in right lower extremity.

Therapy’s result: Swelling and the restriction in mobility of the fascia are not present. Tension in m. semitendinosus is not present but hypertonisity is decreased. M. vastus medialis and .m rectus femoris are in better condition and in next sessions will be in the same level with the muscles of health lower extremity.

5.4.7 Session 7 (16/06/2011)

Report: Patient does not feel good about his knee because he had a small injury on his right knee joint, during a music concert. He feels a small pain and he is afraid to put his whole weight on it. He is afraid to provide full extension and full flexion on knee joint.

Assessment: Swelling is present in same level as first sessions and fascia, also is restricted. M. semitendinosus has tension and hypertonisity has increased after his injury. M. vastus medialis and m. rectus femoris is in the same condition like previous session.

Goals of the therapy:

-Release the pain

-Release the swelling the restriction of the fascia

-Increase the stability of the right knee joint so patient to be able to stand on his injured leg with his whole weight.

-Relax and release the hypertonisity of the m. semitendinosus

-Strength carefully the m. rectus femoris and m. vastus medialis because they look tired

-Correction of patient's gait.

Therapy's procedure:

-Soft tissue techniques for the swelling and fascia

-Stretching exercises for the m. semitendinosus

-Massage to release the tension of the m. semitendinosus

-PIR technique for m. semitendinosus

-PNF, 1st diagonal flexion pattern and 2nd diagonal extension pattern with knee extension for m.vastus medialis and 1st diagonal flexion pattern and 2nd diagonal flexion pattern with knee extension for m. rectus femoris, slow reversal hold technique for strengthening.

-Exercise the patient on posturomed with instructions to provide 2 sets of half step x 5 times on it and 2 sets of one step across it x 5 times with his injured knee joint.

-Exercises in the fitness room: Exercises with the overball, 2 sets of 15 times by holding and pressing overball between his knees. Pressing the overball against bed (ball is placed under knee and afterwards under Achilles tendon). This exercise patient provides it with his leg in neutral position for m. rectus femoris and in internal rotation of the hip joint for m. vastus medialis. 6-7 parts of wobble-boards on the floor and the patient from floor started to walk on this wobble boards for stability exercise. Against the wall 2 sets of squats x 5 times with knees in valgus position. Exercise with 2 sets of 10 times each leg, step forward in squat. Exercise with 3 sets of 10 times with increasing kilos (1^{st} set 5kg, 2^{nd} set 10kg, 3^{rd} set 15kg) to strength the quadriceps muscle group in right lower extremity.

Therapy's result: M. semitendinosus has decreased tension, hypertonisity and pain is not present. Swelling is decreased after the session and fascia has decreased restriction. M. rectus femoris and m. vastus medialis are at the same condition as last session.

5.4.8 Session 8 (17/06/2011)

Report: Patient feels better than the last session and he has confidence that he will become healthy. The pain is not present today and he can provide flexion and extension of knee joint but it has not the physiological range of motion and is 15 degrees less than 0 degrees for the extension and 140 degrees for the flexion of knee.

Assessment: Swelling is on minimum only on the anterior and lateral part of knee joint. Fascia is coming to the physiological level of mobility. M. rectus femoris and m. vastus medialis are also near to the same level of strength with the other lower extremity. M. semitendinosus has slightly tension and not pain, but it is at the same level like before his recent injury. Also m. semitendinosus looks slightly weak.

Goals of the therapy:

-Release exactly the swelling the restriction of the fascia

-Increase the stability of the right knee joint

-Relax and release the hypertonisity of the m. semitendinosus

-Strength carefully the m. rectus femoris and m. vastus medialis, and slightly strengthening of the m. semitendinosus.

-Correction of patient's gait.

Therapy's procedure:

-Soft tissue techniques for the swelling and fascia

-Stretching exercises for the m. semitendinosus

-Massage to release the tension of the m. semitendinosus

-PIR technique for m. semitendinosus

-PNF, 1st diagonal flexion pattern and 2nd diagonal extension pattern with knee extension for m.vastus medialis and 1st diagonal flexion pattern and 2nd diagonal flexion pattern with knee extension for m. rectus femoris, slow reversal hold technique for strengthening.

-Exercise the patient on posturomed with instructions to provide 2 sets of half step x 5 times on it, 2 sets of one step across it x 5 times with his injured knee joint, 2 sets of 5 minutes per set to stand on it with his injured leg.

-Exercises in the fitness room: Exercises with the overball, 2 sets of 15 times by holding and pressing overball between his knees. Pressing the overball against bed (ball is placed under knee and afterwards under Achilles tendon). This exercise patient provides it with his leg in neutral position for m. rectus femoris and in internal rotation of the hip joint for m. vastus medialis. 6-7 parts of wobble-boards on the floor and the patient from floor started to walk on this wobble boards for stability exercise. Against the wall 2 sets of squats x 5 times with knees in valgus position. Exercise with 2 sets of 10 times each leg, step forward in squat. Patient exercises with bicycle for 10 minutes for warm up. Exercise with 3 sets of 10 times with increasing kilos to strength the quadriceps muscle group. Sets for the right lower extremity are (1^{st} set 5kg, 2^{nd} set 10kg, 3^{rd} set 15kg). Sets for the left lower extremity are (1^{st} set 20kg, 2^{nd} set 20kg, 3^{rd} set 20kg). Exercise with 2 sets (1^{st} set 5kg, 2^{nd} set 5kg) of 10 times for strengthening of the hamstrings muscle group but only on the right lower extremity.

Therapy's result: M. semitendinosus has decreased tension, hypertonisity and pain is not present. Swelling is decreased after the session and fascia has decreased restriction. M. rectus femoris and m. vastus medialis are at the same condition as last session.

5.4.9 Session 9 (20/06/2011)

Report: Patient feels very good about his knee and his balance but he is a little bit anxious about it. He can provide extension and flexion of the knee joint, and with one more session it will be in the same level as before the injury.

Assessment: Swelling is not present. Fascia is coming to the physiological level of mobility. M. semitendinosus is slightly hypertonicity and weak. M. rectus femoris and m. vastus medialis are also near to the same level of strength with the other lower extremity

Goals of the therapy:

-Release exactly the restriction of the fascia

-Increase the stability of the right knee joint

-Relax and release the hypertonisity of the m. semitendinosus

-Strength the m. rectus femoris and m. vastus medialis and slightly m. semitendinosus

-Correction of patient's gait.

Therapy's procedure:

-Soft tissue techniques for the fascia

-Stretching exercises for the m. semitendinosus

-PIR technique for m. semitendinosus

-PNF, 1st diagonal flexion pattern and 2nd diagonal extension pattern with knee extension for m.vastus medialis and 1st diagonal flexion pattern and 2nd diagonal flexion pattern with knee extension for m. rectus femoris, slow reversal hold technique for strengthening.

-Exercise the patient on posturomed with instructions to provide 2 sets of half step x 5 times on it, 2 sets of one step across it x 5 times with his injured knee joint, 2 sets of 5 minutes per set to stand on it with his injured leg.

-Exercises in the fitness room: Exercises with the overball, 2 sets of 15 times by holding and pressing overball between his knees. Pressing the overball against bed (ball is placed under knee and afterwards under Achilles tendon). This exercise patient provides it with his leg in neutral position for m. rectus femoris and in internal rotation of the hip joint for m. vastus medialis. 6-7 parts of wobble-boards on the floor and the patient from floor started to walk on this wobble boards for stability exercise. Against the wall 2 sets of squats x 5 times with knees in valgus position. Exercise with 2 sets of 10 times each leg, step forward in squat. Patient exercises with bicycle for 10 minutes for warm up. Exercise with 3 sets of 10 times with increasing kilos to strength the quadriceps muscle group. Sets for the right lower extremity are (1^{st} set 5kg, 2^{nd} set 10kg, 3^{rd} set 15kg). Sets for the left lower extremity are (1^{st} set 20kg, 2^{nd} set 20kg, 3^{rd} set 20kg). Exercise with 2 sets (1^{st} set 5kg, 2^{nd} set 5kg) of 10 times for strengthening of the hamstrings muscle group but only on the right lower extremity.

Therapy's result: It is noticed the improvement day by day of m. rectus femoris and m. vastus medialis. Fascia has normal mobility and m. semitendinosus shows us that it is only matter of time to overcome it.

5.4.10 Session 10 (21/06/2011)

Report: Patient feels that he is in previous level like before his injury and he has self-confidence about his general condition. The extension and the flexion of his knee joint have the normal range of motion like the other leg.

Assessment: Fascia is not restricted. M. semitendinosus is normotonus, painless and without tension. M. rectus femoris and m. vastus medialis are at the physiological level of strength.

Goals of the therapy:

-Maintain the normal stability of the right knee joint

-Maintain the normotonus of the m. semitendinosus

-Moderate strengthening the m. rectus femoris and m. vastus medialis because after the session is the final kinesiologic examination

-Correction of patient's gait.

Therapy's procedure:

-Stretching exercises for the m. semitendinosus

-PIR technique for m. semitendinosus

-PNF, 1st diagonal flexion pattern and 2nd diagonal extension pattern with knee extension for m.vastus medialis and 1st diagonal flexion pattern and 2nd diagonal flexion pattern with knee extension for m. rectus femoris, slow reversal hold technique for strengthening.

-Exercise the patient on posturomed with instructions to provide 2 sets of half step x 5 times on it, 2 sets of one step across it x 5 times with his injured knee joint, 2 sets of 5 minutes per set to stand on it with his injured leg.

-Exercises in the fitness room: Exercises with the overball, 2 sets of 15 times by holding and pressing overball between his knees. Pressing the overball against bed (ball is placed under knee and afterwards under Achilles tendon). This exercise patient provides it with his leg in neutral position for m. rectus femoris and in internal rotation of the hip joint for m. vastus medialis. 6-7 parts of wobble-boards on the floor and the patient from floor started to walk on this wobble boards for stability exercise. Against the wall 2 sets of squats x 5 times with knees in valgus position. Exercise with 2 sets of 10 times each leg, step forward in squat. Patient exercises with bicycle for 10 minutes for warm up. Exercise with 3 sets of 10 times with increasing kilos to strength the quadriceps muscle group. Sets for the right lower extremity are (1st set 5kg, 2nd set 10kg, 3rd set 15kg). Sets for the left lower extremity are (1st set 20kg, 2nd set 20kg, 3rd set 20kg). Exercise with 2 sets (1st set 5kg, 2nd set 5kg) of 10 times for strengthening of the hamstrings muscle group but only on the right lower extremity.

Therapy's result: Patient finished the rehabilitation plan without any problem and without any tension or pain in any muscle. He is in a very good level about his muscles and the stability of his knee joint. Patient feels like before his injury and he is very happy after our cooperation.

5.5 Final Kinesiologic Examination:

5.5.1 Postural examination (by Kendal):

Posterior view:

-Both lower extremities are in slight external rotation.

-Left scapula is slightly higher than the right scapula.

-Both upper extremities are in slightly internal rotation.

-Left shoulder joint is slight higher than the right shoulder joint.

Lateral view:

-More loading on heels.

-Slight physiological lordosis on lumbar spine.

-Trunk goes backward.

-Both upper extremities are in slight internal rotation.

Anterior view:

-Both lower extremities are in slight external rotation.

-Left m. pectoralis major have bigger tone than right pectoralis major muscle.

-Left shoulder joint is slightly higher than the right shoulder joint.

5.5.2 Pelvis examination (by Kendal):

-Physiological anterior tilt of the pelvis.

5.5.3 Trendelenburg Test (one leg standing):

(We ask the patient to stand up on both legs. We ask the patient to lift one leg and to stay in this position for a few seconds. We provided it on both legs).

Right leg: Patient provides it also without any problem and he is standing normally
Left leg: Patient provides it also without any problem and he is standing normally.

With squat:
Right leg: Patient does it without any problem or tremor of his muscles.
Left leg: Patient does it without any problem or tremor of his muscles..

5.5.4 Gait examination (by Kendal):

-Left upper extremity has bigger movement than the right upper extremity.
-His gait examination is symmetrical.

Modification of gait examination:
Walking on tip toes: Patient is able to provide it.
Walking with squats: Patient is able to provide it.

5.5.5 Scale examination:

Right scale: 36 kg
Left scale: 36 kg
The result shows us that patient has the same loading on both legs.

5.5.6 Anthropometry examination (by Kendal):

Measurement	Right lower extremity	Left lower extremity
Anatomical length	83 cm	83 cm
Functional length	88 cm	88cm
Length of the thigh	46 cm	46 cm
Length of the middle leg	37 cm	37 cm
Length of the foot	25 cm	25 cm
Circumference of thigh	Quadriceps: 44.5 cm Vastus Medialis: 40 cm	Quadriceps: 45 cm Vastus Medialis: 40 cm
Circumference of knee joint	34 cm	35 cm
Circumference of the calf	35 cm	35 cm
Circumference of ankle joint	25 cm	25 cm
Circumference of the foot	24 cm	24 cm

5.5.7 Palpation examination (by Kendal):

Muscles:

Right lower extremity:

- M. Quadriceps (m. rectus femoris): normal tonus, hypertrophy
- M. Tensor fasciae latae: hypertonic, normal trophy
- M. Adductors (m. adductor longus, magnus, brevis) : normal tonus, normal trophy
- M. Hamstrings: normal tonus, hypotrophy
- M. Iliopsoas: normal tonus, normal trophy
- M. Gastrocnemius: normal tonus, normal trophy
- M. Gluteus maximus: normal tonus, hypertrophy
- M. Piriformis: normal tonus, normal trophy

Left lower extremity:

- M. Quadriceps (m. rectus femoris): normal tonus, hypertrophy
- M. Tensor fasciae latae: hypertonic, normal trophy
- M. Adductors (m. adductor longus, magnus, brevis): normal tonus, normal trophy
- M. Hamstrings: normal tonus, hypotrophy
- M. Iliopsoas: normal tonus, normal trophy
- M. Gastrocnemius: normal tonus, normal trophy
- M. Gluteus maximus: normal tonus, hypertrophy
- M. Piriformis: normal tonus, normal trophy

Skin and fascias:

Right lower extremity:

- Physiological mobility of the skin around the knee joint.
- Physiological mobility of the fascia around the knee joint.

Left lower extremity:

- Physiological mobility of the skin around the knee joint.
- Physiological mobility of the fascia around the knee joint

5.5.8 Range of motion examination (by Kendal):

Knee joint:

	Right side		Left side	
Motion	**Active movement (degrees)**	**Passive movement (degrees)**	**Active movement (degrees)**	**Passive movement (degrees)**
Extension	0	0	0	0
Flexion	140	160	140	160

Ankle joint:

	Right side		Left side	
Motion	**Active movement (degrees)**	**Passive movement (degrees)**	**Active movement (degrees)**	**Passive movement (degrees)**
Plantar Flexion	40	45	40	45
Dorsiflexion	20	20	15	20

Hip joint:

	Right side		Left side	
Motion	**Active movement (degrees)**	**Passive movement (degrees)**	**Active movement (degrees)**	**Passive movement (degrees)**
Extension	10	10	10	10
Flexion	105	120	110	125
Abduction	40	45	40	45
Adduction	10	10	10	10
External rotation	40	45	40	45
Internal rotation	40	45	40	45

5.5.9 Muscle strength examination (by Kendal):

Muscle	Right lower extremity	Left lower extremity
Quadriceps	5	5
Hamstrings	5	5
Adductors	5	5
Tensor fasciae latae	4	4
Gastrocnemius	5	5
Iliopsoas	5	5

5.5.10 Muscle length examination (by Kendal):

Muscle	Right lower extremity	Left lower extremity
Quadriceps	0	0
Hamstrings	1	1
Adductors	0	0
Tensor fasciae latae	0	0
Gastrocnemius	0	0
Iliopsoas	0	0

5.5.11 Joint play examination (by Lewitt):

The patient was examined for possible restrictions of knee joint, ankle joint, tarsal-metatarsal joints and metatarsal-phalangeal joints on both lower extremities. There was not any restriction on these joints in every direction. Also, examination was done on head of fibula, patella and talocrural joint, and there was not present any restriction on them.

5.5.12 Neurological examination (by Lewit):

- Deep sensation test: Negative
- Lasseque test: Negative
- Rhomberg test: Negative
- Superficial sensation test: Negative

Patient was examined for tendon reflexes according to Lewit:

- Patellar tendon: 2
- Achilles tendon: 2

Notice: The neurological examination and the examination of reflexes was done on both lower extremities.

5.5.13 Specific test for instability examination of knee joint:

- Anterior drawer test: Negative
- Lachman test: Negative
- Posterior drawer test: Negative
- Valgus and varus stress test: Negative

5.5.14 Examination for stability on posturomed:

Patient stands on posturomed in the beginning on both legs and then after our instructions, he tried to stand on one leg or to provide a step on it. After a while it starts to move with his weight. With the help of this instrument is visible to notice, if there is good stability or not on the knee and if the tremor of the muscles, which are around it, is taking place.

Patient is able to stand on both legs on it without any difficulty. When the patient took the instructions to provide it with his injury leg he provided it with physiological level of stability. Also, patient provided it with physiological level of stability when he did it with his healthy leg.

Same results we noticed when the patient tried to provide a step on it with his injured leg that the patient could do it normally.

The result of our examination was negative because patient could provide these examinations without any problem and with a normal level of stability on his both lower extremities without any difference between them.

5.5.15 Final examination conclusion:

With the end of 10 sessions with the patient, I made reevaluation of the patient, to see the results of the rehabilitation plan which I follow. In the first sessions patient was slightly afraid with the condition of his knee joint and with the possibilities of success of the therapy. When patient started to feel better with his knee joint then the therapy was affectively. After the 6^{th} session patient had an injury and there was the fear that he will be again to the starting level from the first sessions. However we did not have such a problem in our cooperation and the results are noticeable. Specifically the range of motion was increased from session to session, the starting pain and swelling it was noticed that they decreased. The condition of short and tensed muscle which was m. semitendinosus became better after our therapies during the sessions. Also m. rectus femoris and m. vastus medialis became more powerful with the strengthening exercises. The last step was also successful which was the increasing of his stability of the knee joint.

6 Evaluation of the effects of the therapy:

After the end of the rehabilitation which I followed for my patient I noticed all the therapies showed me successful results about the condition of the patient. My estimation is that the most effectively therapy which I applied during the sessions was Proprioceptive Neuromuscular Facilitation (P.N.F.). This method with the technique slow reversal hold, helped me to strength the m. rectus femoris and m. vastus medialis which were weak. However, an effectively therapy was, also, Post Isometric Relaxation (P.I.R.) for the relaxing of tensed muscle which was m. semitendinosus. The results were noticeable. When the sessions finished, in final kinesiologic examination patient had not any pain or swelling on his knee joint and he could provide full flexion and extension of the knee joint. One more thing was about patient's confidence which was very nice. He was feeling like his previous condition. My estimation is that there was not some therapy more which I could do and the reason is that the injury of my patient was not so bad and the situation was not so difficult. Probably it could be possible some more sensomotoric exercises about his stability which was very good after the end of the therapies.

7 Conclusion:

After 10 sessions, I did the final kinesiologic examination. I saw that patient had a great improvement about his condition when he injured his knee joint and in the end of our rehabilitation plan. I am very happy because patient trust me to help him to return to his previous level before his injury. After this period I noticed that a physiotherapist can help a person who has really bigger problems with the help of knowledge from our university. Patient feels very good and stable with his both lower extremities and as he told me, he is ready to return and start to do his favorite sports without any fear of injury. My estimation is that this patient will not present similar injuries and his condition will be in a better level than now after the passing of the time. The reason is that he is sportive person and he likes to do several sports from every kind of them. Also, he is young and with good condition of his muscles in his whole body.

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9. List of Figures

10. Model Informed Consent:

INFORMOVANÝ SOUHLAS

V souladu se Zákonem o péči o zdraví lidu (§ 23 odst. 2 zákona č.20/1966 Sb.) a Úmluvou o lidských právech a biomedicíně č. 96/2001, Vás žádám o souhlas k vyšetření a následné terapii. Dále Vás žádám o souhlas k nahlížení do Vaší dokumentace osobou získávající způsobilost k výkonu zdravotnického povolání v rámci praktické výuky a s uveřejněním výsledků terapie v rámci bakalářské práce na FTVS UK. Osobní data v této studii nebudou uvedena.

Dnešního dne jsem byla odborným pracovníkem poučena o plánovaném vyšetření a následné terapii. Prohlašuji a svým dále uvedeným vlastnoručním podpisem potvrzuji, že odborný pracovník, který mi poskytl poučení, mi osobně vysvětlil vše, co je obsahem tohoto písemného informovaného souhlasu, a měla jsem možnost klást mu otázky, na které mi řádně odpověděl.
Prohlašuji, že jsem shora uvedenému poučení plně porozuměla a výslovně souhlasím s provedením vyšetření a následnou terapií.
Souhlasím s nahlížením níže jmenované osoby do mé dokumentace a s uveřejněním výsledků terapie v rámci studie.

Datum:………………………………………

Osoba, která provedla poučení:………………………………………

Podpis osoby, která provedla poučení:……………………………………

Vlastnoruční podpis pacienta /tky:…………………………………….

11. Ethic Committee: